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COST AND SCHEDULE CONTROL MANAGEMENT : WHAT
THE DEPARTMENT OF DEFENSE MAJOR ACQUISITION
SYSTEM PROGRAM MANAGER NEEDS TO KNOW

by

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Cost and Schedule Control Management : What the Department of Defense
Major Acquisition System Program Manager Needs to Know

by

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ABSTRACT

In view of the current fiscal environment, marked by severe constraint and rapidly declining defense dollars, the Office of the Secretary of Defense has launched an effort to bring about better programmatic cost and schedule control for major defense acquisition programs. Thus, it is imperative for the DoD major system program manager to achieve a thorough understanding of cost and schedule control management and apply these principles to management decision making. This thesis will focus on what the DoD major system program manager should understand to accomplish this, by familiarizing the reader with the Cost Performance Report, its implementation, and report analysis. The thesis will also examine "lessons learned" as a result of the Navy A-12 Avenger termination and will discuss recent Office of the Secretary of Defense and military Service initiatives to improve cost and schedule management. Finally, this thesis will provide the researcher's recommendations for future DoD cost and schedule management improvement.

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I. INTRODUCTION

A. BACKGROUND

The Department of Defense's (DoD's) interest in the cost and schedule performance of significant acquisition contracts has heightened significantly over the last two years. In view of the current fiscal environment, marked by severe constraint and rapidly declining budget dollars for defense spending, the Office of the Secretary of Defense (OSD) has launched an all out effort to bring about better programmatic control of cost and schedule for defense programs. In addition to "tighter money", OSD's revised interest in cost and schedule management is in direct response to the rapid erosion of public and congressional consensus for higher defense spending, the uproar over the cost overruns, schedule slippages, and performance shortfalls evidenced within the U.S. Air Force's B-2 Stealth Bomber and C-17 Military Airlift programs, and the U.S. Navy's A-12 Avenger program.

On 8 January 1991, the A-12 Avenger program was abruptly terminated by the Secretary of Defense, Mr. Dick Cheney, because, among other issues, it was found that both the contractor and the Navy had made inadequate use of cost/schedule data to manage and control cost and schedule parameters. According to Pentagon spokesman, Pete Williams, "We have lost faith in the ability of everyone to perform

under this current contract" [Ref. 1:p. 1]. As a direct result of the A-12's demise, the Navy's Program Executive Officer (Tactical Aircraft Programs) and A-12 Program Manager were relieved.

The A-12's termination has sent a clear message to the Department of Defense. First and foremost, the defense acquisition community must cultivate improved information flow and analysis so that decision makers can determine early in the acquisition process whether program cost targets, production schedules, and performance thresholds are being met. Second, the acquisition force must implement steps to become proactive versus remaining reactive. Third, the consequences for failure to implement and use effective cost/schedule management practices can result in program termination. Finally, the A-12's termination sends the message that OSD is committed to bringing about greater realism regarding the projections of cost, schedule, and performance of both current and new major system starts.

It is obvious, that acquisition in the 90s will be characterized by ever-tightening controls and increased congressional and DoD oversight of all major contracts and subcontracts to ensure strict performance goals are reached within delineated cost and schedule limits. Therefore, DoD major program managers must achieve a thorough understanding of cost and schedule control management such as the Cost/Schedule Control Systems Criteria (C/SCSC) and principles

such as "earned value", and then rigorously apply those principles to the management of their acquisition programs.

B. RESEARCH OBJECTIVE

The objective of this research is to provide the future program manager with an understanding of the importance of cost and schedule control management in major acquisition programs. First, this research will furnish a substantive review of the Cost/Schedule Control Systems Criteria (C/SCSC) process, and aspects of performance measurement and control. Second, this thesis will address the earned value management approach and point out its utility. Third, it will provide the program manager with an understanding of some of the non-commercial software packages that are available to assist in cost and schedule management. Fourth, this thesis will analyze the cost and schedule control management implementation process, and the impact that the Navy's A-12 Avenger Program termination has had on the cost and schedule environment within DoD. Finally, this research will provide the program manager guidance on how to achieve successful program management through cost and schedule control.

C. RESEARCH QUESTIONS

The primary research question is:

"What should the program manager understand to achieve successful cost and schedule control in major acquisition

programs and what affect has the Cost Performance Report had on program cost and schedule performance?"

The following subsidiary questions were formulated to define the primary research question:

1. What are the key aspects of the DoD Cost/Schedule Control Systems Criteria (C/SCSC)?
2. What is the current policy and practice for validating contractor (cost/schedule) management systems?
3. How does/should the program office/program manager utilize the data provided in the Cost Performance Report?
4. How does the Government determine an appropriate threshold to measure cost/schedule variance?
5. What is meant by rebaselining and what affect does it have on a program's C/SCSC?
6. What are some of the software packages available to the program manager to assist in cost and schedule data analysis?
7. What are some of the major shortfalls associated with the C/SCSC process and how might it be improved?
8. What impact has the Navy's A-12 Avenger program termination had on the DoD C/SCSC environment and are there any applicable lessons learned?

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

1. Scope

This thesis focuses on what the DoD major acquisition program manager should understand regarding cost and schedule control management. This document provides a comprehensive look at C/SCSC, its implementation process, and its application to cost and schedule control management. This thesis traces the history of the cost and schedule control

concept and addresses how the cost and schedule management process can be improved.

2. Limitations

This thesis is limited in scope to C/SCSC and its application within the context of significant acquisitions programs.

3. Assumptions

A major program is considered any program in which C/SCSC is applied. To avoid confusion, the term major program will be used synonymously with significant program throughout the paper. Also, contractor performance is measured in terms of their ability to remain within cost, schedule, and technical parameters defined by the contract.

E. METHODOLOGY

The research for this thesis was conducted through a comprehensive literature search encompassing several texts, papers, articles, DoD regulations, directives, guides, briefings, and other publications. A series of Defense Logistics Studies Information Exchange (DLSIE) and Defense Technical Information Center (DTIC) searches were also made.

Further information on C/SCSC, cost/schedule control management, and cost/schedule performance measurement was obtained via telephonic and personal interviews with various personnel associated with cost/schedule control policy development and implementation, cost/schedule surveillance,

and program management. The personnel interviewed included representatives within the Office of the Under Secretary of Defense (Acquisition) Acquisition Policy and Program Integration, members of the Performance Measurement Joint Executive Group, and C/SCSC experts from the Defense Systems Management College.

A week long research trip to the Army Aviation Systems Command (AVSCOM) in St. Louis, Missouri, permitted the researcher the opportunity to talk with various program managers, program business managers, program analysts, and cost/schedule analysts from the AVSCOM matrix structure. The program offices that were visited include Commanche Light Helicopter, Longbow/Apache Attack Helicopter, Kiowa Warrior Helicopter, Aircraft Survivability Equipment, Blackhawk Helicopter, and Aircraft Avionics. The Cost and Economic Systems Division within the Systems and Cost Analysis Directorate of AVSCOM was also visited.

Various trips to some of the Defense Contract Management Area Operation (DCMAO) offices including Sunnyvale and San Bruno, California provided the researcher with the opportunity to talk with several program and technical support analysts about contract cost and schedule surveillance. Additional information and expertise associated with cost/schedule control management was obtained through researcher attendance at the three day 1991 C/SCSC National Workshop. This workshop exposed the researcher to a plethora of cost and schedule

control experts from DoD, all military Services, the National Performance Management Association, the National Security Industrial Association, and the Society of Cost Estimating and Analysis.

F. DEFINITIONS AND ABBREVIATIONS

Definitions used within this thesis are included as Appendix A. Abbreviations used within this thesis are included as Appendix B.

G. ORGANIZATION OF THE STUDY

This thesis is organized into five chapters. Chapter I is a general introduction presenting the research questions, objectives, methodology, and organization of this study. Chapter II provides background regarding the evolution of cost/schedule control management and discusses the C/SCSC philosophy and the criteria in terms of five categories. This chapter also introduces the Cost Performance Report (CPR), describing its purpose, structure, and interface with other higher level reports. Finally, chapter II addresses the key DoD organizations associated with C/SCSC policy development and/or implementation. Chapter III provides an explanation of the C/SCSC process. Specifically, this chapter will outline the Government's C/SCSC interface during the preaward phase of the contract, negotiation or competition phase, and the post award phase. Chapter IV provides a discussion of the Cost

Performance Report (CPR) and concentrates on aspects of CPR analysis. In addition, this chapter will address Program Manager (PM) management actions regarding C/SCSC problems and also will provide insight into some of the CPR analysis packages that are currently available. Chapter V examines the U.S. Navy's A-12 Avenger program termination and analyzes the impacts that this program's termination has had on the DoD cost and schedule environment. This chapter also provides a discussion on some of the key A-12 "lessons learned." Chapter VI presents an analysis of selected aspects of the cost and schedule control process. Specifically the analysis will center on program preaward activities, demonstration review process, CPR utility, and the program office's CPR analysis capability. Throughout the analysis the discussion will offer recommendations for improvement in the cost/schedule management process. Finally, chapter VII will provide conclusions and recommendations generated by this research.

II. EVOLUTION, PHILOSOPHY, AND ORGANIZATION OF C/SCSC

A. CHAPTER INTRODUCTION

Declining defense budgets, the rising costs of weapon systems, and the President's call for substantive reform in defense acquisition, has placed increased emphasis on cost and schedule management of major programs. More than ever before, the Program Manager must thoroughly understand the elements of the Cost/Schedule Control Systems Criteria (C/SCSC) and use it effectively in program execution. This chapter will provide the Program Manager with a background of C/SCSC. Specifically, the chapter will describe the historical development of C/SCSC, discuss the purpose and aspects of the criteria, and provide an account of the DoD organizations associated with C/SCSC policy development and implementation.

B. HISTORICAL PERSPECTIVE

Cost and schedule management is not a new concept within the Department of Defense. This concept and practice has been in existence in one form or another for over thirty years. During the late 1950s through the 1960s, the Government program manager was confronted with a very complex and arduous requirement of managing major programs in an environment characterized by increasing economic inflation, expanded technological complexity, long lead procurement times, and

growing uncertainty within the defense industry [Ref. 2: pp. 36-38]. At that time, program managers had neither a prescribed project control methodology nor an existing DoD cost/schedule control criteria to manage their programs.

The Navy was responsible for one of the earliest program control methods by introducing a criteria approach to project control called Program Evaluation and Review Technique (PERT). PERT was specifically developed for use in the management of the Navy's Polaris Fleet Ballistic Missile Program in the late 1950s and early 1960s [Ref. 3:p. 13]. In response to the management challenge posed by the Polaris project, the Department of the Navy's Strategic Systems Project Office directed that all associated prime contractors and major sub-contractors would use the PERT process.

The PERT process provided the Navy with a useful method of linking planned events with tasks, to portray an activity network throughout the span of the program schedule. A key product of PERT was the identification of the critical path of tasks, or the longest sequential path of events through the program [Ref. 4:p. 23]. Careful management of the critical path meant program completion in the least amount of time and money. At the center of the PERT process was the concept of the work breakdown structure (WBS). The WBS represents the manner in which a program is structured through successive levels of detail. The WBS, by definition, is a product-oriented family tree composed of hardware, services, and data

resulting from program efforts during product development and production [Ref. 5:p. 2]. It defines the product to be developed and later to be produced. It relates the elements of work to be accomplished to each other and to the desired end product to trace costs and facilitate program management.

Shortly after the advent of PERT, an upgraded PERT, PERT-Cost, was developed and employed by the Government on all major contracts. PERT-Cost, "added the capability to budget and report costs by PERT network activities" [Ref. 3:p. 13]. Unfortunately, industry viewed the PERT techniques as largely impractical, cumbersome, and just another requirement to fulfill. As a result, contractors created special PERT groups whose sole purpose was to satisfy Government PERT requirements. This practice created a couple of problems for the Government. First, these special groups operated apart from contractor management teams who were responsible for planning, scheduling, budgeting, and measuring the program's performance. This condition resulted in redundant and often conflicting contractor performance information passed onto the Government program office. Second, these groups resulted in increased overhead costs with little or no value added. Invariably, the PERT-Cost requirements were "negotiated into contracts on top of perfectly valid existing contractor management and control systems". [Ref. 3: p. 13]. The Government eventually concluded that its mandate of PERT and PERT-Cost was a poor investment. Despite overall success in

the Polaris program, PERT was viewed a failure largely because of poor Government implementation and inadequate computer technology sufficient to support it.

Concurrent with the implementation of PERT-Cost, the U.S. Air Force pursued continued work in criteria based approaches to obtain program status information. In 1963, the Air Force, as part of the Minuteman Missile Program, instituted a contractor management control system concept "based on a set of management criteria to be included in the contract statement of work" [Ref. 3:p. 14]. This Management Control System concept, was designated as "earned value". Earned value refers to the measurement of the program work actually accomplished compared to the budget spent by the contractor. The Air Force's earned value added several improvements to PERT-Cost. It provided a description of what the contractor's management systems should be capable of accomplishing versus mandating a specific preferred Government management system. Also, based on lessons learned from PERT-Cost implementation, the Air Force instituted the concept of on-site contractor system demonstrations aimed at eliminating duplicate contractor management systems [Ref 3. p. 14].

The Air Force expanded upon this management control system concept by developing a set of simplified standards to qualify a contractor's internal management systems for defense work [Ref. 3:p. 14]. The standards incorporated the strong points of both earned value and the PERT-Cost method concept. These

standards, called the *Cost/Schedule Planning and Control Specification* (or C-Spec) were published in 1966 by the Air Force Systems Command. The C-Spec standards became the foundation for DoD's Cost/Schedule Control Systems Criteria (C/SCSC). The C-Spec represented those attributes that a capable contractor management control system should exhibit. C-Spec permitted the contractor to establish and utilize the internal processes of his choosing; however, it required that he demonstrate his process compliance with the C-Spec.

DoD published the C/SCSC in 1967 within DoD Instruction (DoDI) 7000.2, *Performance Measurement for Selected Acquisitions*. DoDI 7000.2 provided policy guidance for implementing C/SCSC on a DoD wide basis. The DoDI 7000.2 applied to various cost contract types, other than firm fixed price, within major acquisition programs. A major acquisition program was defined by the 1987 DoD Directive 5000.1, *Major and Non-Major Acquisition Programs*, as one that had an estimated dollar value for research, development, test, and evaluation (RDT&E) of more than \$40 dollars or had an estimated dollar value for production of more than \$160 million.

The intent of the criteria approach discussed in DoDI 7000.2 was to provide the contractor flexibility in his internal operations, while providing the Government with a standard of measure that ensured the contractor's management system exhibited the characteristics and capabilities

considered inherent in an effective cost and schedule control system. The key objectives of DoDI 7000.2 were to:

1. Obtain assurance that the contractor's internal management systems were adequate.
2. Guarantee the contractor's system provided, reliable, and integrated cost, schedule, and technical performance data indicating work progress and ensuring a practical level of summarization.
3. Ensure a single system was utilized for the purpose of management reporting.
4. Avoid imposition of specific methods or techniques on the contractor.
5. Maximize use of the contractor's existing system, minimizing changes to it. [Ref. 4: pp. 313-314.]

DoDI 7000.2 also authorized the development of a joint C/SCSC implementation guide designed to amplify the concepts outlined in DoDI 7000.2 and standardize C/SCSC implementation procedures. As a result, DoD established a tri-service working group in 1967 known as the Performance Measurement Joint Executive Group (PMJEG). *The Cost/Schedule Control Systems Criteria Joint Implementation Guide* (JIG) was issued in August 1970. It has been updated four times since 1970. The JIG provided uniform procedures for all DoD components to be utilized, "...during planning and implementation of the DoD Cost/Schedule Control Systems Criteria (C/SCSC) and for surveillance of contractor compliance" [Ref. 6:p. i]. By 1972, all Services were actively using the JIG to implement C/SCSC on all applicable contracts.

In February 1991, DoDI 7000.2 was cancelled and incorporated into DoDI 5000.2, *Defense Acquisition Management Policies and Procedures* Part 11, "Program Control and Review". The C/SCSC is found within part 11, Section B, Attachment 1, and a series of C/SCSC terms are defined within Attachment 2 of that same Section. Part 11, Section C, outlines the milestone review procedures and the documentation required by phase for C/SCSC applied programs. References to the various reports associated with cost and schedule control are not discussed within DoDI 5000.2, rather they are covered within DoD 5000.2-M, *Defense Acquisition Management Documentation and Reports*, part 20, "Cost Management Reports". Part 20 replaces DoDI 7000.1, *Contractor Cost Performance Fund Status and Cost/Schedule Status Reports* and DoDI 7000.11, *Contractor Cost Data Reporting*.

No significant differences in C/SCSC policy from DoDI 7000.2 are apparent in DoDI 5000.2; however, there are changes in C/SCSC applicability thresholds. For example, DoDI 5000.2, Part 11, requires C/SCSC compliance on all significant contracts and sub-contracts. A significant contract is an RDT&E contract valued at \$60 million or more, or a procurement contract with a value of \$250 million or more (in FY 1990 dollars) [Ref. 7: p. 11-B-2]. Application of C/SCSC to firm fixed price type contracts is still not necessary; however, DoDI 5000.2, Part 11, does state that, "Exceptions may be made

by the milestone decision authority for individual contracts"
[Ref. 7:p. 11-B-3].

C. THE C/SCSC PHILOSOPHY

DoD's C/SCSC policy does not prescribe a specific system to be utilized by major contractors or sub-contractors for the purposes of program cost/schedule performance management. According to DoD Directive 5000.1, "Contractors shall not be required to revise existing systems except as necessary to satisfy DoD criteria" [Ref. 8:p. 1-6]. Instead, C/SCSC prescribes 35 criteria to serve as standards for measuring the acceptability of the contractor's internal management control systems. Acceptable or adequate contractor systems are those which provide effective, timely, reliable, and auditable information for use by both the contractor and the Government to evaluate cost and schedule performance. C/SCSC gives the contractor the latitude to organize in a fashion that best complements company working environment and management philosophy. In addition, the contractor is free to choose whatever methods or internal operating procedures they desire. The contractor's management control systems can be automated, manual, or some combination of both, provided the end result is an integrated management system that satisfies DoD's C/SCSC policy.

D. THE FIVE AREAS OF C/SCSC

The C/SCSC is composed of 35 criteria which specify the types of information which the contractor's internal management control system must provide. The 35 criteria are grouped into five major categories:

1. Organization- Definition of the contractual effort through use of a work breakdown structure (WBS) and identification of those responsible for the performance of work. All of this must be linked by means of an integrated contractor management control system (ICMCS). (ICMCS refers to the integration of scheduling, budgeting, work authorization, cost accumulation systems with one another, the WBS, and the contractor organization structure.)
2. Planning and Budgeting - Establishment and maintenance of detailed plans, schedules, and budgets for authorized work. These detailed plans, schedules, and budgets combined to form the performance measurement baseline (PMB). Additionally, this category identifies such things as physical products, milestones, and technical performance goals to be used to measure output.
3. Accounting - Accumulation, recording, and summarization of all direct labor and material costs and all indirect costs such that an earned value comparison provides an evaluation of the performance measurement plan (Budgeted Cost of Work Scheduled or BCWS) versus the actual contractor performance (Budgeted Cost of Work Performed or BCWP). In simple terms, earned value is the measure of what is produced for what is spent. All costs must be traceable to the WBS and organizational elements.
4. Analysis - Comparison of planned and actual cost, and schedule performance data. The contractor identifies, analyzes, and explains significant differences, or variances, between actual and planned cost/schedule performance. Additionally, the contractor must produce responsible estimates at completion (EACs). An EAC refers to a value expressed in dollars and/or hours which is the sum of cumulative actuals, or incurred costs to date, and the realistic cost estimate of work yet to be done referred to as the estimate to completion (ETC).

5. Revisions and Access to Data- The contractor must show the effects of contractual changes to budgets and schedules. The contractor will incorporate these contractual changes into the controlled baseline or Contract Budget Base (CBB). (The CBB is the negotiated contract cost or Performance Measurement Baseline (PMB), plus any Management Reserve (MR), as well as the estimated cost of any unpriced, authorized work.) This category also specifies a requirement to notify the procuring activity of any changes made to the PMB and provide authorized Government representatives access to all contract information for criteria compliance determination. [Ref. 6:pp. 2-3 to 2-5]

E. GOVERNMENT ORGANIZATIONS ASSOCIATED WITH C/SCSC

There are a number of Government organizations that contribute to C/SCSC policy development and implementation. These organizations include the Acquisition Policy and Program Integration/Cost Management (AP&PI/CM) section within the Office of the Under Secretary of Defense (Acquisition), the Performance Measurement Joint Executive Group (PMJEG), the Defense Contract Audit Agency (DCAA), and the Defense Logistics Agency (DLA).

The AP&PI/CM is charged with acquisition policy development and implementation. This office is assigned the responsibility of implementing C/SCSC throughout DoD, and oversight of major contractor cost management reports. The personnel within this office also review contractor cost performance data submitted by the various Service departments and submits assessments of the data to senior DoD management including the Under Secretary of Defense (Acquisition) [Ref. 10].

The PMJEG is responsible for providing top level, joint policy and procedure recommendations regarding C/SCSC. This group also provides uniform C/SCSC interpretation, arbitration, and coordination with industry. Each Service component commodity command is represented on the PMJEG. DLA, DCAA, and the National Security Agency (NSA) are also standard members of the group.

In addition to its PMJEG role, the DCAA plays an important part in the C/SCSC implementation process. This organization has significant responsibilities in the areas of contractor systems reviews and contractor performance surveillance. These responsibilities specifically include monitoring contractor system integrity, utilizing contractor system output, coordinating surveillance reviews with the Administrative Contracting Officer (ACO), and providing risk assessment of the contractor's Estimate at Completion (EAC).

The DLA is also closely involved in the C/SCSC implementation process. The Defense Logistics Agency, through its Defense Contract Management Command (DCMC), provides contract administrative services to the military program office. The DCMC is organized into five continental Defense Contract Management Districts (DCMD). Each DCMD provides contract administration services for the customers assigned to it. Each DCMC has several Defense Plant Representative Offices (DPROs) and Defense Contract Management Area Operations (DCMAO). Each of these organizations provides

contract administrative services, program support evaluation, contractor performance analysis, and contractor C/SCSC system surveillance to the DoD buying command. A DPRO is co-located with a major defense contractor, whereas, a DCMAO will be given responsibility for a group of contracts within their geographical area. [Ref 11.]

F. CHAPTER SUMMARY

Chapter II has provided the evaluation, philosophy, and organization of the Cost/Schedule Control Systems Criteria. It also introduced some of the key C/SCSC documentation including DODI 5000.2, DOD 5000.2-M, and the Joint Implementation Guide, and focused on the objectives and details of the C/SCSC. Finally, Chapter II discussed some of the organizations responsible for C/SCSC policy development and implementation.

Chapter III will continue to add upon the material discussed in Chapter II. First, Chapter III will work through the C/SCSC implementation process. Second, this chapter will provide the PM with an understanding of the surveillance process. The surveillance process discussion will focus on contractor control system validation, the surveillance plan, and the memorandum of agreement.

III. C/SCSC IMPLEMENTATION

A. CHAPTER INTRODUCTION

Chapter III will give the PM an understanding of his role in the C/SCSC implementation process. This chapter will outline the Government's C/SCSC interface with the contractor during the preaward phase of the contract. The discussion will focus on the actions that need to be taken to ensure an adequate program structure is established that will provide timely, accurate contract cost and schedule information. This chapter will also discuss the post award phase of the C/SCSC implementation process. The discussion of post award elements will concentrate on the performance measurement baseline, emphasizing its early establishment and maintenance. Finally, this chapter will address contractor system validation. This discussion will include a description of the various validation reviews. In addition, the surveillance plan and the Memorandum of Agreement will be addressed.

B. PREAWARD: REQUEST FOR PROPOSAL

C/SCSC implementation begins for the program manager with the contract preaward process. The preaward process is very important because this is where the PM sets the stage for the project's cost/schedule control management program. Activities which occur during the preaward phase affect many

later activities during the contract's execution. The competitive process begins through the issuance of a solicitation or Request-For-Proposal (RFP) to prospective contractors.

The RFP is an official procurement document that communicates the program manager's requirements to potential contractors. According to LTG Billy M. Thomas, Deputy Commanding General, Research, Development, and Acquisition, U.S. Army Material Command, the RFP is where, "We set the standard for everything we buy" [Ref. 12:p. 5]. Additionally, RFPs have caught the interest of the USD(A), the Honorable Donald Yockey. Currently, the OUSD(A) has established a policy to examine key acquisition documents, such as the RFP, for major programs under OSD's review before RFP release.

The RFP identifies to prospective contractors a series of items to be addressed in their proposals such as Contract Data Requirements Lists (CDRLs), a Statement of Work (SOW), and a proposed Contract Work Breakdown Structure (CWBS). The Government prepares the CDRL which correlates to the SOW requirement. It is a listing of data requirements specified to be provided by the contractor. The CDRLs will generally include contractor deliverables such as analyses, status reports, technical drawings, manuals, and manufacturing management data. The CDRLs will include an explanatory Data Item Description (DID) for each data item listed. The DID

describes the purpose of the data item, applications, interface references, and data preparation needs [Ref. 38:p. 10-8]. For a C/SCSC applied contract, the PM will include the Cost Performance Report (CPR) as a required data item. The PM will specify the CPR submission frequency, the required CWBS reporting level, and the variance thresholds. A threshold is a contractually prescribed outer limit cost and schedule parameter.

The SOW is the RFP's requirements statement. It identifies to the contractor the required contractual tasks. For example, the SOW will address several contract aspects such as contract line items, configuration items, contract work statement, and the contract specifications. Most importantly, the SOW provides the contractor with a focus to his organization, and to plan and allocate his resources.

The importance of the SOW cannot be overemphasized. It is important, not only because it defines the scope of work, but also because it clarifies the Government's requirements and the contractor's responsibilities and obligations throughout the duration of the contract. Upon contract award, the SOW will become the standard for measuring the contractor's technical performance.

The program manager will normally provide a preliminary contract work breakdown structure as part of the RFP or solicitation. This initial CWBS is the program manager's preliminary definition of the product to be delivered. The

CWBS establishes the structure for reporting and measuring contract cost and schedule performance. This structure identifies the WBS levels and elements for which cost and schedule data will be reported. The CWBS is incorporated into the CPR for the purposes of program planning and reporting status.¹ According to DoD policy, CPR reporting is usually limited to the first three levels of the CWBS; however, the program manager may elect to extend the reporting level to lower levels based on his assessment of program risk [Ref. 6:p. 8-1]. The depth of the CWBS levels should be to the extent necessary to ensure adequate program planning, control, and support. According to MIL-STD-881A, *Military Standard Work Breakdown Structures for Defense Material Items*, "the contractor has complete flexibility in extending the CWBS to reflect how his work is to be accomplished" [Ref. 39:p. 11].

The RFP will establish various parameters in addition to the CWBS. Some of the parameters to be established include the reports required of the contractor, report frequency by type, report due dates, and variance threshold values. The RFP will also provide a program schedule. The PM should ensure that the schedule reflects the CWBS structure and supports all contract requirements. The program schedule

¹The CPR is a monthly DoD report that is generated by the contractor to obtain cost and schedule status information for program management.

represents the overall sequence of work and it provides a plan for how the work will be accomplished in a given time frame.

C. PREAWARD: VARIANCE THRESHOLD ESTABLISHMENT

The contract's C/SCSC variance thresholds should be addressed in the Government's RFP. Appropriate variance threshold selection is critical to successful C/SCSC implementation. According to the C/SCSC, contractor explanation is required whenever a significant variance results. A significant variance is any difference between planned and actual performance that exceeds the prescribed thresholds. A significant variance can either involve cost, schedule, or both. Variance thresholds are normally applied to the project summary level CWBS elements that are specified to be reported within the contract.

The PM's selection of meaningful thresholds is important because they will prevent excessive, counterproductive variance analysis, while still providing sufficient visibility of program cost and schedule problems. The Joint Implementation Guide (JIG) indicates that no particular threshold, or set of thresholds, is optimal for all situations. In addition, the JIG recommends that the PM obtain provisions in the contract for modifying thresholds whenever they become ineffective or unproductive [Ref. 6:p. 3-17].

There are various approaches the PM can apply when setting thresholds. One method entails establishing a variance threshold based on a percentage of the budgeted cost of work scheduled (BCWS) or budgeted cost of work performed (BCWP) and a fixed dollar amount.² An example of this method would be to set the variance thresholds at 10% BCWP or BCWS and \$100,000. This method is easy to understand; however, there can be a pitfall. If a variance threshold is set too high (i.e., 25% BCWP or BCWS and \$500,000) then, significant cost and schedule problems could arise before the PM gets visibility.

Another approach is to require variance analysis when the cumulative variances exceed a specified percentage of BCWS or BCWP for the first half of the program, and a smaller percentage for the remainder. For example, a PM could set a 10% threshold for the first half of the program and 5% for the second half. This illustrates a stair-step function threshold that assumes that the contractor's performance will improve as he nears the end of the program. OSD has an established "thumb rule" which indicates that such an expectation may not be very

²BCWS is the value of all work scheduled to be accomplished plus the amount of level of effort and apportioned effort as of the CPR's cut-off date. Level of effort (LOE) refers to activities that are supportive in nature (i.e., project management functions) and it is normally measured by noting the passage of time (i.e., for LOE, BCWP = BCWS). Apportioned effort may be discrete in nature, but its accomplishment is directly related to the performance of other work. Quality assurance activities would be an example of apportioned effort. BCWP is the value of all completed work packages and all portions of open work packages, plus the appropriate amount of LOE and apportioned effort as of the CPR's cut-off date.

realistic. For example, suppose a contract that is 15% or more completed-to-date has an overrun in cost and/or schedule. The thumb rule states that the overrun at completion will either be equal to the overrun to date or the percent overrun at completion will be greater than the percent overrun to date [Ref 4:p. 272]. History shows that a contractor's performance will not improve, rather, it shows that the contractor's performance will either remain the same or worsen over time.

Another method uses a non-linear variance threshold throughout the span of the program. An example of this type of threshold is expressed by the formula:

$$(.005) \times (BAC) \times \frac{\sqrt{CumBCWP}}{BAC}$$

BAC refers to the budget at completion which is the value of all work packages allocated to the contract. BAC equals the sum of the BCWS at completion. "CUM" refers to cumulative or total to date.

This approach avoids the stair-step function pitfall; however, the formula is complex and may be difficult to follow.

In addition, this approach is limited in that it only addresses cumulative to date cost and schedule performance. For example, suppose for a 60 month contract the prescribed thresholds are exceeded in month 12. The cumulative to date variances that would be addressed in format five of the CPR in month 12 would continue to be the same variances addressed in all succeeding months. [Ref. 13:p. 13] In essence, all follow-on CPR narratives would become carbon copies of month

12. This results in old problems overshadowing new ones. The PM can improve upon this method by establishing a current month threshold besides the cumulative to date thresholds. This modification would provide the necessary visibility of any new problems.

Finally, the PM could establish thresholds that require variance analysis for only the top 50% of the cost and schedule drivers that exceed a prescribed dollar value. This technique has the benefit of keying in on those contract items that reflect the greatest risk and/or cost. A variation on this approach could be to restrict variance analysis to only the top ten or twenty dollar amount or highest percentage items. The Air Force Space Systems Division in Los Angeles California has used this variation with moderate success [Ref. 14]. According to one OSD analyst this is becoming the preferred method for threshold establishment [Ref. 10].

In conclusion, it is very important that the PM establish and maintain meaningful variance thresholds throughout the program's duration. The PM must recognize the inherent jeopardy in setting thresholds before the establishment of a contractor performance measurement baseline (PMB).³ The PM may discover that the variance thresholds may no longer be appropriate once the PMB has been established and operated by the contractor. It is, therefore, recommended that the PM

³The PMB is the time phased budget plan against which project performance is measured.

conduct a periodic review (i.e., every six months) of his variance thresholds and modify them as the situation dictates.

D. PREAWARD: THE RFP C/SCSC SOLICITATION CLAUSE AND COMPLIANCE PLAN

It is through the RFP that the prospective contractor begins to understand the PM's concern regarding cost, schedule and technical risk issues. The various elements of the RFP set into motion the cost and schedule (C/S) control implementation process for the contract requiring C/SCSC. Undoubtedly, a poorly written RFP that doesn't adequately reflect the program manager's project needs will result in subsequent contract changes. These changes probably will translate into excessive costs for the Government regarding C/SCSC implementation and subsequent C/S management. One principal way the program manager specifies his requirements regarding C/SCSC is the inclusion of the C/SCSC contract clause 252.234-7001. The full text clause is contained in Appendix C. The C/SCSC contract clause stipulates:

1. A contractor will use only approved C/SCSC management systems throughout the performance of the contract.
2. A contractor will be ready to demonstrate his system's compliance with the C/SCSC standards to a Government Review Team within 90 days (or as otherwise specified) after contract award.
3. A contractor must ensure all relevant documents, data, and records associated with his management systems are readily accessible for Government review and surveillance.

4. A contractor will ensure all changes to an already accepted system is Government approved prior to implementation.
5. Any changes required of a contractor management system to meet the C/S criteria will be made at the contractor's expense.
6. When set forth in a contract (mutual agreement between the Government and the prime contractor), selected sub-contractors under the prime's control will meet C/SCSC standards to include all provisions regarding system review, demonstration, and surveillance. [Ref. 18:pp. 252.234-2,3]

In addition, each contractor will submit a comprehensive C/SCSC compliance plan for the management systems they intend to use to execute the contract. Appendix D contains the exact Defense Federal Acquisition Regulation Supplement (DFARS) language regarding the C/SCSC compliance plan requirements. According to the DFARS, the potential contractor's plan must accomplish the following:

1. Describe the contractor's management system and explain how his system will interface in all major function cost areas (i.e., manufacturing, tooling, and engineering) in relation to the WBS, planning, budgeting, scheduling, work authorization, cost accumulation, measurement and reporting of cost and schedule performance, variance analysis, and PMB control.
2. Describe in detail how the contractor's management system complies with each of the 35 criteria.
3. Name all major sub-contractors, or as a minimum identify the contractual effort earmarked for sub-contract and incongruities with C/SCSC.
4. Discuss how C/SCSC administration will be applied to applicable sub-contractors. [Ref. 18:p. 252.234-1]

In response to the Government's C/SCSC clauses, the potential contractor will conduct a thorough evaluation of the

RFP and determine required resources, develop preliminary schedules, propose budgets, and identify any risks he feels exist within the contract. Based on these assessments, the prospective contractor will coordinate his organization's efforts, develop a negotiation or discussion strategy, and then submit his proposal.

The PM should ensure that the RFP is complete and clearly specifies program requirements before submission to prospective contractors. This is important because contract award can be made based upon the initial contractor proposal. In addition, it is important that C/SCSC requirements are clarified in the RFP and throughout the preaward process. To do otherwise, could result in contractor misunderstandings that might cause significant cost and schedule performance shortfalls later in the program.

E. PREAWARD CONTRACTOR PROPOSALS

In response to the Government's solicitation or RFP, the potential offeror will conduct a thorough evaluation of the RFP and determine the required resources, develop preliminary schedules, propose budget, and identify any risks he believes may exist within the contract. Based on these assessments, the prospective offeror will coordinate his organization's efforts, develop a strategy, and then submit his proposal.

In compliance with the RFP C/SCSC requirements, the prospective offeror's proposal will provide a detailed

description of his existing internal cost management systems and discuss his comprehensive C/SCSC compliance plan. In addition, the offeror's proposal may recommend changes to the preliminary CWBS provided in the RFP [Ref. 39:p. 5].

F. PREAWARD: NEGOTIATIONS OR DISCUSSIONS

If contract award is not made based upon the offeror's initial proposal, then negotiations or discussions will ensue between the Government and the contractor. It is during this point of the preaward process that all participants begin "to develop a common understanding of risk and resource requirements needed to structure the program" [Ref. 16:p. 3]. Depending on the type of contract in question, a contract target cost or an estimated contract cost will be established. The contract target cost or estimated contract cost represents the base dollar figure to accomplish the contract. This contract cost will serve both as a point of departure and a target for the prospective contractor to develop his internal budgets. These internal budgets are developed at the contractor's work package level and are summed to the cost account level. A work package represents detailed, short-span efforts identified for accomplishing work required to complete the contract [Ref. 15:p. 11]. A cost account can include several work packages and it is where functional responsibility for the work is assigned. As a management

control point, the cost account is where actual costs are collected and compared to the budgeted cost of work performed.

The contract target cost or estimated contract cost also represents the budget base figure from which the prospective contractor will derive his performance measurement baseline. The potential contractor develops his PMB through the integration of the target cost (estimated contract cost), the SOW, and the formalized CWBS. Once the contract has been awarded, the contractor's subsequent contract cost and schedule performance will be evaluated against the PMB.

G. POST AWARD: ESTABLISHMENT OF THE PERFORMANCE MEASUREMENT BASELINE

The C/SCSC implementation process continues after contract award. At this point in the process, the contractor will establish a management reserve (MR). The MR is a portion of the negotiated contract target cost or estimated contract cost that is set aside for management control purposes to cover contingencies.

The MR is not part of the initial PMB, and the amount of MR is based upon the contractor's judgment. It will usually average between 8% to 12% of the contract target cost or estimated contract cost [Ref. 16:p. 3]. As a thumb rule, the greater the risk or cost; or the shorter the contract span, the higher the management reserve will be [Ref. 8]. Typical uses of the MR include covering unplanned work within the

scope of the contract, rework, and cost offsets for rate adjustments. The contractor must not; however, use MR to cover cost variances [Ref. 15:p. 15].

The PM should pay close attention to the use of the MR, particularly during the first half of the contract effort. Early use of the management reserve could suggest a potential contractor performance problem. The contractor is required to report to the PM any change in the MR balance via the CPR. The contractor's report will specify the amount of MR change, the WBS elements that require the MR, and the rationale for its use. Once the management reserve has been established, the remaining contract budget will be allocated down to the various contractor cost account levels where cost, schedule, and technical performance responsibilities are delegated.

Once the the contractor has established the MR, he will establish his detailed PMB and begin to operate within it. A detailed PMB is essential to successful cost and schedule management. According to the JIG, a detailed PMB represents a concrete time-phased budget plan that extends as far out into the future as is feasible [Ref. 6:p. 3-9]. The PM should insist upon a PMB level of detail that supports his assessment of program risk and the contractor's past performance record. The PM should ensure that the contractor establishes a detailed PMB as soon as practical after contract award. At the very least, a detailed baseline needs to be in place for all near term work (four to six months). The absence of a

near term PMB can result in an early loss of accurate contract performance evaluation. According to an OSD cost analyst, "Failure by the PM to get the awarded contractor on-line with an early, concrete PMB will preclude initial, valid cost and schedule reporting" [Ref. 10].

There are means available to the PM to stimulate a contractor's urgency to establish a timely, detailed PMB. One Defense Systems Management College, Cost Performance Measurement Curriculum Professor advocates using progress payments and/or contract in progress reviews to motivate contractors to come on-line early after contract award with a detailed PMB [Ref 14]. The amount of payment of certain progress payments can be made contingent upon establishment of a valid, detailed PMB by a certain time frame. In the other case, the PM could link the establishment of the contractor's detailed PMB to a periodic in progress performance review. As part of the review, the contractor could be asked to formally discuss his detailed PMB. Either approach can provide the PM with the means to motivate the contractor to establish a timely detailed PMB.

H. THE PMB CHANGE PROCESS

Successful program cost and schedule control is not only tied to effective baseline establishment; but also to its maintenance. Once a detailed PMB has been established to the extent that earned value can be determined, the difficult task

of maintaining its integrity begins.⁴ The PMB is a "living guideline" and should not be thought of as something rigid and immutable.

The PMB can change frequently throughout the span of the contract. It is imperative to the integrity of cost and schedule performance evaluation, that the PM ensures all changes are carefully managed and are traceable to their sources. Contract modifications should be formally documented and incorporated into the PMB as soon as possible to avoid distortions in contract performance reporting. The PM should be aware of some basic rules that apply to PMB control:

1. The contractor may not rebudget work packages that are underway.
2. The contractor is not authorized to make retroactive adjustments to budgets for completed work.

Changes to the PMB can involve contractor rebaselining. Rebaselining can take the form of either replanning or reprogramming. Replanning involves a change in the original PMB plan and includes internal and external replanning. Internal replanning results from a need by the contractor to compensate for cost, schedule, or technical problems encountered that have made the original PMB unrealistic [Ref. 4:p. 518]. The intent of internal replanning is to give the contractor the flexibility to deal with cost and schedule problems that arise and that are within the scope of work.

⁴Earned value is the measurement of the amount of work that has been accomplished on a contract in terms of budgeted dollars.

For example, the contractor will occasionally find it necessary to replan tasks into a different time frame, replan future work in a more efficient manner, or apply management reserve. The contractor can internally replan without the PM's approval if the contract target cost or estimated cost is not exceeded; however, they should notify the PM.

There are some more general rules that apply to baseline control under internal replanning:

1. The contractor cannot rebudget in-process work packages.
2. The contractor is not authorized to adjust finished work budgets.
3. The contractor is prohibited from reopening completed work packages.
4. The contractor must not transfer work tasks from one cost account to another without transferring the internal budget earmarked for them. [Ref. 4: p. 73]

The PM can protect himself from surprise, by incorporating up-front in the contract, a requirement for the contractor to brief his baseline plan during periodic contractor/Government reviews. In addition, the PM could request that the Procuring Contracting Officer (PCO) establish a clause within the contract that directs the contractor to inform the Government whenever internal replanning occurs.

External replanning results from Government directed changes or constructive changes to the contract. This kind of change may or may not remain within the scope of the original contract; however, it will quite often result in a change in the scope of the contract. Under this change condition, the

contractor will assess the impact of the Government's changes and provide his cost estimate to the Government. Again, the PM should verify cost realism. The contractor must not change his contract budget base (CBB) until the contract change is authorized formally by the Government through a contract modification.⁵

The result of a directed change or constructive change will require the contractor to externally replan work effort. When a contractor externally replans, the previous PMB curve will be adjusted to accommodate the directed changes. Consequently, for a cost type contract, increased scope or added work will probably mean an increase in the contract target cost or estimated contract cost. On a final note, contract internal replanning can eliminate schedule performance variances to date; however, cost performance variances will continue to be evident on the CPR because the total allocated budget remains linked to the CBB [Ref. 4:p. 212].

Reprogramming occurs when the total contract budget base is insufficient to cover the remaining authorized work. In this situation, the contractor will seek relief from his current PMB by requesting Government approval to go to an over target baseline.⁶ A contractor request to go to an over target

⁵The CBB is the negotiated or discussed contract cost plus any estimated cost of authorized, yet unpriced work.

⁶An OTB is a baseline which results from formal reprogramming approved by the Government.

baseline is, in essence, a formal declaration of an overrun condition. At this point, the contractor must formally request the Government's approval to manage to a higher target cost or estimated contract cost.

An OTB should not be a frequent event and should only happen when major problems exist in the contract. Formal reprogramming or going to an OTB involves a complete, major restructuring of the remaining effort of the contract and a requirement for some additional contract funding. Under a cost-reimbursable type contract, the contractor's profit or fee probably will be adjusted to reflect the contractor's now over target baseline plan.

An over target baseline will affect the contractor's future performance reporting. It is important that the PM clearly understands the OTB's impact on contractor performance reporting. A new baseline will be built on top of the overrun baseline. In addition, all contract cost and schedule variances will usually be eliminated or zeroed out; therefore, for cost and schedule performance reporting, the contract essentially starts over. Once these variances are made, the adjustment applicable to each reported WBS element affected, will be entered in column 12 of format one of the CPR.⁷ An example of the CPR's format one can be found in Appendix E.

⁷CPR format one provides data to measure cost and related data for measuring contractor's cost and schedule performance by summary level work breakdown structure elements. CPR formats will be discussed in further detail in Chapter IV.

The total of column 12 will equal the amount shown on the variance adjustment line in column 11 of format one of the CPR [Ref. 27:p. 16F]. The elimination of the previous cost and schedule performance variances is important for management purposes. If these variances were not zeroed out once the OTB was established, the contractor's performance reports would not reflect accurate or meaningful cost and schedule information. In essence, any new cost and/or schedule problems would be obscured by the previous cost and schedule variances. By zeroing out previous cost and schedule performance variances, the PM can maintain clear visibility of the contractor's future contract cost and schedule performance.

As stated previously in this chapter, the establishment and maintenance of the PMB are the most significant aspects of contractor performance measurement. It is important that the PM start off right regarding the PMB, particularly for a program that is in the research and development stage of the acquisition process. The PM can help his management efforts by identifying key technical review points along the span of the program during the negotiation process.

The PM should insist that the planning effort continue as the contractual effort is accomplished. In addition, at each identified review point, the program's cost, schedule, and technical performance should be assessed. This assessment should include provisions to review the adequacy of the

contract target cost or estimated contract cost, and create a catalyst for detailed planning for the next review point.

I. C/SCSC VALIDATION

Another step in the C/SCSC implementation process involves the validation or verification of the contractor's management control system. Validation represents phase one of the C/SCSC surveillance process that begins after the award of the contract and continues through system demonstration and acceptance. The validation process includes a series of reviews conducted by a Government review team of selected representatives from the program office and Defense Contract Management Command.

The validation is designed to evaluate or verify that a contractor's internal control management practices and procedures are effective, fulfill the C/SCSC, and generate valid data. There are varying degrees of review application depending upon whether the awarded contractor has a previously accepted C/SCSC management system. Contractors who have a previously accepted system will usually cite in their proposal the formal notice of prior acceptance of their system and use a memorandum of understanding (MOU) that states the contractor's agreement to use his accepted system on all contracts that require C/SCSC. Based on this, and any previous experience with the awarded contractor, the ACO together with the PM and members of his staff, will determine

the type of review process to be used. Contractors who have a previously accepted system can expect to undergo a Subsequent Application Review (SAR) or an Extended Subsequent Application Review (ESAR).

The SAR is a more informal review. It is usually short in duration (3 to 5 days). Normally, contractors should expect to be ready for a SAR within 90 days after contract award. The purpose of the SAR is not to reassess a contractor's previously accepted system, but to verify that the contractor is correctly and effectively applying the accepted system (revised with any approved changes) on the new contract [Ref. 6:pp. 7-1 - 7-3]. As a final note on SARs, they are used as often as necessary, throughout the performance of the contract to ensure that the contractor's re-validated system is still being used [Ref. 17].

The ESAR also can be applied to a contractor who has had a previously accepted system. The ESAR differs from the SAR in that it is more formal and usually requires about ten days to complete. An ESAR is performed whenever contractor conditions have altered, such as when programs have moved from one phase to another (e.g., development to production), whenever programs are moved or extended or when a contractor's previously accepted C/SCSC system description has had extensive revisions [Ref. 6:p. 5-3]. As with the SAR, a contractor who is designated to receive an ESAR should expect to be ready within 90 days after contract award.

For the contractor who does not have a previously accepted C/SCSC system, a different set of review actions occurs. Upon award of a contract requiring C/SCSC, the contractor can expect to receive an Implementation Visit (preliminary review) followed by a Readiness Assessment Review. Finally, when ready, the contractor will undergo a Demonstration Review to validate his system.

The Implementation Visit occurs after contract award (usually within 30 days) and involves an initial visit by representatives from the Government C/SCSC Review Team to the contractor's plant facility. The purpose of this visit is to accomplish the following:

1. Establish a preliminary dialogue between both parties and review the contractor's plans for implementation of his C/SCSC system on the newly awarded contract.
2. Identify any deficiencies or shortcomings regarding C/SCSC compliance and clarify any misinterpretations that the contractor may have with respect to the 35 criteria and their implementation within his management system.
3. Contractor will normally conduct briefings aimed at providing to the Government representatives a preliminary understanding of the contractor's systems design and operation. Additionally, the Government will examine several documents (such as system procedures, budgets, performance reports, schedules, etc.)
4. Establish a date and schedule for a readiness assessment review. [Ref 6:p. 5-3]

The Readiness Assessment Review involves a series of meetings between the Government Demonstration Review Team and

the contractor.⁸ It usually occurs about 30 days after the Implementation Visit. The purpose of the Readiness Review is to decide whether the contractor's system is ready for a Demonstration Review. As with the Implementation Visit, contractor deficiencies are identified for correction and key team members of the Government Review Team are further familiarized with the contractor's management systems in preparation for the full-scale Demonstration Review. Any system deficiencies found during the Readiness review must be corrected prior to the Demonstration Review.

The Demonstration Review is an in-depth examination of the contractor's management control systems, designed to ascertain whether the contractor's system complies with the criteria and is being used. Of all the reviews, the Demonstration Review is the most complex and intense. The Government's Review Team is usually composed of 15-20 people who will spend three to four weeks at the contractor's facility interviewing a series of different personnel (cost account managers, functional managers, schedulers, etc.) and examining all pertinent documents (ledgers, logs, control charts, initial cost performance reports, etc.) associated with budgeting, work authorization, and accounting to ascertain contractor C/SCSC compliance. The Demonstration Review also will investigate the prime contractor's actions or procedures to ensure, as

⁸The Government demonstration review team will consist of persons from the following organizations, program office, matrix support, DCAA, and the CAO.

appropriate, that each of his sub-contractor's systems is in compliance with C/SCSC. According to the Joint Implementation Guide, "The prime contractor is responsible for the review and acceptance of each sub-contractor's management control system that requires application of C/SCSC unless the Government has accepted the responsibility because of a request from either the prime or sub-contractor for the Government to perform the review" [Ref. 6:p. 5-46].

The Demonstration Review concludes with a formal report that discusses all team actions and findings. The team's report will state whether the contractor's management system is adequate and meets the C/SCSC. If the contractor's system fails to comply with the criteria, the report will outline in detail all areas of non-compliance. If the contractor should fail the Demonstration Review, they must implement corrective actions and undergo follow-up reviews until their system is accepted and receives a letter of validation.

After a contractor's management control system has been either re-validated, or accepted for the first time, the second phase of the C/SCSC surveillance process involves the formalization of the surveillance plan and the establishment of a Memorandum of Agreement (MOA) between the Contract Administration Office and the Program Manager. The surveillance plan provides a structured, in-depth outline of surveillance responsibilities, procedures and techniques to be used in the performance of C/SCSC surveillance on a specific

contractor management control system. The plan's specific design is based on the program manager's concerns, contractual requirements, the nature of the management control system to be monitored, and the availability of surveillance personnel.

The surveillance plan consists of two parts. The first part is general in nature and describes such issues as organization responsibilities, frequency of reports (i.e., CPR), and the review cycle (i.e., SARs every 12 months). Part two is very specific and discusses what contractor areas will be evaluated and surveillance techniques to be used. The end goal of the plan is to ensure that:

1. The accepted contractor's system continues to be used.
2. Valid and timely contract performance measurement information is provided.
3. Actual or potential problems are identified early.
4. Surveillance efforts, between the CAO and the program manager, remain coordinated. [Ref. 6:p. 6-1]

A Memorandum of Agreement (MOA) is established, between the cognizant CAO and the program office, to ensure that surveillance responsibilities are understood. The provisions of the MOA will vary depending upon the Military Department involved, CAO capabilities, and the PM's desires [Ref. 19:p. 3-9]. The MOA is developed in consonance with the surveillance plan and is normally activated before the finish of a Demonstration Review or SAR. The MOA should provide a means for resolving problems and promoting better communications. In addition, it minimizes duplication of

efforts, and functions in concert with the surveillance plan to explain fully, the C/SCSC surveillance to be accomplished.

J. CHAPTER SUMMARY

In chapter III, the C/SCSC implementation process was discussed. This chapter focused on the Government's C/SCSC interface with the contractor during the contract preaward, negotiation/competition, and post award phases. Chapter III also focused on the establishment and maintenance of the performance measurement baseline. Finally, this chapter described the contractor C/SCSC validation process. The "validation process" discussion addressed the various system reviews and provided insight into the surveillance plan.

Chapter IV will focus on aspects of contract cost and schedule analysis. This chapter will discuss the Cost Performance Report, including its format and function. In addition, it will concentrate on aspects of CPR analysis and provide the PM with an understanding of earned value methods. This chapter will also address some options that the PM can use when his analysis indicates contractor cost and schedule management problems. Finally, Chapter IV will expose the PM to some software packages that are available to assist him in his performance analysis efforts.

IV. COST PERFORMANCE REPORT ANALYSIS, MANAGEMENT ACTIONS, AND SOFTWARE TOOLS

A. CHAPTER INTRODUCTION

Chapter IV will address contract cost and schedule performance analysis. The discussion will focus on the Cost Performance Report, including its format and function. In addition, it will concentrate on the aspects of CPR analysis. It will provide the PM with an appreciation of the impact of this analysis on program cost and schedule management. Chapter IV also will describe some options the PM can take when his contractor's performance analysis shows cost and schedule problems and/or C/SCSC compliance problems. Finally, Chapter IV will discuss some software packages that are available to assist the PM with performance analysis.

B. THE COST PERFORMANCE REPORT (CPR)

DoDI 5000.2 does not specify any formal reporting requirements or formats for the contractor. It does state, however, that the contractor's management control systems shall include policies, procedures, and methods that are designed to ensure that the contractor shall accomplish the considerations highlighted in Attachment 1, entitled "C/SCSC" [Ref. 7:p. 11-B-2]. C/SCSC also does not mandate that the

contractor submit any specific report. Instead, the criteria require that the contractor's internal management systems will have the capability to produce and report certain types of data. For example, Attachment 1, C/SCSC, states that the contractor's management control systems will, "Identify on a monthly basis, the cost detail needed by management for effective control, including cost variances with reasons for significant variances" [Ref. 7:p. 11-B-1-3]. It is Government practice to use the Cost Performance Report (CPR) for C/SCSC applied contracts.

The CPR is the principal Government document to measure the contractor's contract performance on a major defense contract.⁹ DoD 5000.2-M, Part 20, Section 3B states that the CPR is required on all contracts which must comply with C/SCSC [Ref. 9:p. 20-7]. The CPR is prepared by the contractor on a monthly basis and provides structured, summary level cost and schedule information. This information must be generated directly from the same systems used for internal contractor management. The CPR's purpose is to provide the PM with the status of his program and the impact of any problems. In addition, the CPR provides the PM with a basis for detailed

⁹This report is covered within DoD 5000.2-M, Part 20, "Cost Management Reports", pp. 20-7 through 20-8. The CPR applies to any contract requiring C/SCSC compliance and also to development and procurement contracts having dollar thresholds of \$60 million and \$280 million respectively in FY 1980 dollars.

analysis of contractor cost and schedule data and a means to identify any adverse trends. The report should be used by the Government surveillance personnel to monitor and evaluate cumulative actual work performed versus planned work, and cumulative actual costs incurred versus budgeted costs. The CPR is also used to report to Congress whenever the contractor exceeds the 15% and 25% thresholds established by the Nunn-McCurdy Amendment.¹⁰ When used as a management tool, the CPR can provide indications of actual and potential cost and schedule problems, including the impact of previous management corrective actions. The CPR is also useful in quantifying problems discovered through DPRO surveillance.

The CPR consists of five different formats. The first format provides data for the measurement of contractor cost and schedule performance by summary level WBS elements. The purpose of format one is to show the cost and schedule variance associated with each WBS element [Ref. 4:p. 233]. The specific data elements discussed in format one include:

1. Budgeted Cost of Work Scheduled (BCWS) - This is the value of all work scheduled to be accomplished plus

¹⁰The Nunn-McCurdy Amendment requires a report to Congress when a system's total program unit cost and/or annual procurement unit cost exceeds the system's Selected Acquisition Report's baseline by 15% and 25% respectively.

the amount of level of effort and apportioned effort as of the CPR's cutoff date.¹¹ BCWS is listed by each WBS element.

2. Actual Cost of Work Performed (ACWP)- This is the overall cost, both direct and indirect, incurred and recorded in the accomplishment of the work performed within a given period of time. ACWP is listed by each WBS element.
3. Budgeted Cost of Work Performed (BCWP)- This is the value of all work packages completed and portions of open work packages, plus the appropriate amount of LOE and apportioned effort as of the CPR's cut-off date. BCWP is also listed by each WBS element.
4. Schedule Variance (SV)- This represents the difference between BCWP and BCWS specified work.
5. Cost Variance (CV)- This represents the difference between BCWP and ACWP for specified work. The current month CV is the cost variance for a given month and the present cumulative CV is the total cost variance for the contract up to date.
6. Budget at Completion (BAC)- This is the value allocated to each WBS element within the contract. BAC is also equal to the sum of the aggregate BCWS at completion.
7. Estimate at Completion (EAC)- This is the estimate of actual contract direct and indirect costs allocable to the contract, plus those direct and indirect costs estimated for any authorized work remaining.
8. Undistributed Budget (UB)- This is the budget applicable to any known or scheduled work effort that

¹¹ As stated previously in Chapter III, LOE refers to general or supportive type work which cannot be associated with a definable end product and is unable to be controlled by time-phased budgets. Daily contractor program management would be an example of LOE type work. Apportioned effort refers to effort that by itself is not readily divisible into short-span work packages; however, is related directly to the performance of other work. For example, quality assurance inspections would be treated as apportioned effort.

has not yet been linked to a specific WBS element for detailed planning. UB is recognized as a temporary holding account.

9. Management Reserve (MR) - This represents the amount of money the contractor has withheld from the budget base for management control purposes. This money is not part of the PMB, but is part of the contract budget base.

The second format provides information about the same data elements addressed in format one; however, the second format is sorted by the contractor's organizational or functional structure versus the work break down structure used in format one.

Format three shows the performance measurement baseline (PMB) which reflects the contractor's initial target costs, projections for the remainder of the program at six month intervals, and any changes which have occurred to the PMB during the report period. In essence, this format provides a summary of the PMB (including changes), UB, and MR.

Format four uses the same functional categories used in format two. This format indicates the contract manpower requirements. It shows actual man months (vs. actual dollar costs as in format two) consumed for the report period and cumulative to date, a manpower usage forecast (in terms of man months) for the next six months, and a total manpower forecast at completion.

Format five is perhaps the most important format of the CPR for the program manager. It provides an analysis summary

report of major problems to date and explains any major changes to the baseline. Finally, it addresses all significant cost and schedule variances which exceed thresholds. As stated previously in Chapter III, whenever contractually prescribed thresholds are exceeded, a significant variance results. Each significant variance requires a separate performance analysis report discussing the variance's impact on the program. Additionally, each analysis report will include the contractor's plan to rectify the significant cost and/or schedule variance problems(s).

The CPR supports the development of other management oversight reports from the program manager to higher authority. These reports include the Defense Acquisition Executive Summary (DAES) and the Selected Acquisition Report (SAR). The DAES is prepared by the program office and submitted quarterly by the PM to the Program Executive Officer (PEO), and also to the Component Acquisition Executive and the Under Secretary of Defense (Acquisition) to reflect program status updates. The DAES report is designed to provide advance warning of program problems before they become significant [Ref. 9: p. 16-1]. The data from the CPR is found within Section 7 of the DAES, "Supplemental Cost Information".

The SAR is also prepared by the program office and is submitted annually to Congress. The SAR provides a summary of key costs, schedule, technical baseline information, and

program variance analysis relative to a baseline total program unit cost and a yearly unit cost value recorded in the baseline SAR for the contract [Ref. 9:p. 17-1]. CPR data is used for completing Section 8, "Threshold Breaches," Section 9, "Schedule," Section 15, "Contract Information," and Section 17, "Production Rate Data" of the SAR. The Integrated Program Summary report also incorporates CPR data in order to provide the current execution status of the contract cost estimate-at-completion (EAC), program schedule, and the program's achieved performance [Ref. 9:p. 4-A-2].

C. CPR DATA ANALYSIS

The CPR provides the PM with the data necessary to evaluate the contractor's performance. Analysis of these data by the PM and his staff, should support three objectives. First, the analysis should focus on identifying any negative trends. Negative trends will indicate a need for the PM to conduct further research in order to isolate specific problem areas. This research may require additional, more detailed information about various summary level WBS elements addressed in the CPR. Second, the analysis should concentrate on evaluating the contractor's performance against his PMB plan. Finally, the analysis should provide the PM with the ability

to project how the contract will conclude in terms of cost and schedule parameters, given current contractor performance.

D. CPR ANALYSIS TOOLS

From a problem solving standpoint, formats one and five of the CPR will provide all the essential data elements that the PM and program staff need to analyze the contractor's performance. These elements were addressed previously in the CPR format discussion of this chapter. From these elements, the contract schedule variance, cost variance, cost/schedule performance indices, and the variance at completion can be calculated.

The schedule variance (SV) quantifies schedule deviation in dollars [Ref. 20:p. 4-5]. This value can also be equated to time (days, months, etc.) to provide the PM with a clear understanding of to what degree the project is behind or ahead of schedule. The SV is calculated as the difference between work scheduled and work performed ($SV = BCWP - BCWS$). If the variance is positive, then the SV indicates a favorable, or ahead of schedule status. If the SV is negative, then the SV indicates a behind schedule condition.

The SV is a measure of in-process work only because the SV is zero before work is started or planned to start, and zero after work is finished or planned to finish [Ref. 21:p. 5]. The PM should recognize that the SV may not reflect the

contract's critical path.¹² The SV is not a replacement for time-related scheduling systems such as PERT/CPM and GANTT; however, schedule status information should be relatable, regardless of which system is used [Ref. 20:p. 4-5]. For example, if the time-related system indicates a behind schedule condition, yet the SV is positive, then perhaps work which is being done ahead of schedule is counterbalancing behind shedule work. On the other hand, this situation might also suggest that the contractor's BCWS and BCWP data are questionable. If the validity of the BCWS and/or BCWP is in question, the PM should investigate further by requesting additional data from the contractor and/or request his DPRO conduct a special investigation to determine the facts.

Cost variance (CV) is determined as the difference between budgeted costs and actual costs for all work performed ($CV = BCWP - ACWP$). A positive CV reflects a favorable or cost underrun condition, while a negative CV indicates an unfavorable or cost overrun program status. As stated previously in this chapter, all significant variances must be investigated, explained and acted upon by the contractor. However, it should be emphasized that negative CVs are not always the result of poor contractor performance. Negative

¹²The critical path is the longest event path in time throughout the program. Any slippage of an activity or event on the critical path will impact program completion.

CVs may result from poor, up-front cost estimates, or economic factors such as inflation [Ref. 20:p. 4-6]. In any case, when significant CVs occur, the PM should investigate the cause(s) and concentrate his efforts on controlling cost growth throughout the remaining effort.

There are three key cost/schedule performance indicators used in analyzing CPR data. These include the Cost Performance Index (CPI), the To Complete Performance Index (TCPI), and the Schedule Performance Index (SPI). The CPI indicates the amount of work that was completed versus the dollars spent. It is calculated as $BCWP/ACWP$, and it represents return on the dollar or cost efficiency. The higher the CPI, the greater the cost efficiency. For example, if the CPI equals 1.0, then the program is on cost; however, if the CPI is equal to .9, then it means that for every one dollar spent, only \$.90 of the work is completed (i.e., leading to a cost overrun).

The TCPI also represents the return on the dollar. It is calculated as $(BAC - BCWP) / (BAC - ACWP)$. The TCPI shows how efficient the contractor's CPI will have to be on the remaining contractual effort in order not to experience a cost overrun. For example, if the TCPI equals 1.2, then the contractor's CPI must be at least equal to 1.2 for the remainder of the contract, or the program will result in a cost overrun.

The SPI indicates the schedule efficiency with which work has been done and is calculated as $BCWP / BCWS$. An SPI of less than one, indicates a behind schedule condition. For example, if the SPI is equal to .97, then only 97% of the work scheduled has been accomplished.

The Variance at Completion (VAC) is the projection of the cost variance at contract completion. The VAC is calculated as $BAC - EAC$. A positive VAC equates to an underrun condition at completion and a negative VAC means an overrun condition at completion. The VAC value will depend upon how the EAC is calculated.¹³

E. ESTIMATES AT COMPLETION

The EAC is addressed in format one of the CPR. It should be developed by those contractor personnel who are well informed regarding anticipated work performance and problems, future resource costs, and future business requirements [Ref. 20:p. 4-7]. During the early phases of the program, the formula: $EAC = ACWP + (BAC - BCWP)$ is considered to be an appropriate approach [Ref. 20:p. 3-3]. As time progresses;

¹³The EAC value can be calculated using a variety of formulas that can result in significantly different numbers. EAC's have a tendency to reflect contractor optimism and may be understated. An optimistic EAC value may not accurately reflect the contract's performance. Consequently, a VAC value that is based on an unrealistic or overly optimistic EAC may also be understated.

however, there may be reason to believe that past performance is no longer indicative of future performance. When this happens, the EAC formula should incorporate any or all of the cost/schedule performance indices to generate a more realistic EAC.

There has been considerable debate over which EAC formula best represents a program at a specific CPR reporting point. According to a study developed for the Naval Weapons Engineering Support Activity, the accuracy of an EAC method is very dependent upon whether a contract is in its early, middle, or last stages [Ref. 22:p. 5]. The study provided a recommended template of EAC formulas to use based on the stage of a contract's completion.

The study proposed that a relevant range of EAC's for early or middle contract completion stages could be obtained using the following formulas:

$$1. \text{ EAC (1) } = \text{ BAC } / \text{ CPI(cum) }^{14}$$

$$2. \text{ EAC (2) } = \text{ ACWP(cum) } + [\text{BCWR} / (\text{CPI} / (\text{CPI cum}) \times \text{SPI cum})]^{15}$$

¹⁴For each EAC formula, there will be a number in parentheses following the abbreviation EAC. This number signifies a specific EAC formula. This identification method will be used throughout the discussion on the EAC formulas, proposed by the Naval Weapons Engineering Support Activity Study.

¹⁵BCWR refers to the Budgeted Cost of Work Remaining. It is the difference between BAC and BCWP(cum). The Naval Weapons Engineering Support Activity Study introduced this term.

$$3. \text{ EAC (3) } = \text{ACWP(cum)} + (\text{BCWR/CPI}^*)^{16} \text{ [Ref. 23:p. 4]}$$

For contracts in later completion stages, a relevant range of EAC's could be derived using the following formulas:

1. EAC (3) = same as above
2. EAC (4) = $\text{ACWP(cum)} + (\text{BCWR/CPI}^{**})^{17}$
3. EAC (5) = $\text{ACWP(cum)} + (\text{BCWR/CPI}^{***})^{18}$ [Ref. 23:p. 4]

The reader will note, that there are apparent differences between the range of EAC formulas calculated for early or middle stage contracts and those calculated for later stage contracts. The SPI is the more relevant performance indicator during the early stages of the contract. This is because the SPI will eventually equate itself to one, later in the contract, assuming the contract is not terminated [Ref. 23: p. 5]. Because of this SPI characteristic, SPI is not used to calculate EACs in contracts that are in their later stages of completion.

The other significant difference is how the CPI is calculated for early or middle stage contacts versus later stage contacts. For early or middle stage contracts, a cumulative CPI is used; whereas, it is not for the later stage

¹⁶CPI* is calculated using the sum of the latest three months current BCWP, divided by the sum of the latest three months current ACWP.

¹⁷CPI** is calculated using the average of the CPI from the current period plus CPIs from the last 11 months.

¹⁸CPI *** is calculated using the latest six months current BCWP divided by the latest six months current ACWP.

contracts. The reason for this is that cumulative cost variance figures can conceal the effect of recent cost variances [Ref 23:p. 5]. Under both circumstances, the study concluded that EAC(3) was appropriate for use, because it provides a near term perspective based upon a CPI calculated using a three month moving average for both BCWP and ACWP [Ref. 23:p. 5].

The Air Force Systems Command (AFSC) advocates using a single EAC formula that uses a combination of a weighted CPI and SPI to date. The AFSC EAC formula is calculated as follows:

$$\text{EAC} = \text{ACWP} + (\text{BAC} - \text{BCWP}) / (.2\text{SPI} + .8\text{CPI}) \quad [\text{Ref. 25:p. 8}]$$

Various Air Force studies have shown the AFSC EAC to be a reliable forecasting EAC. For example, an Aeronautical Systems Division study found that the .2/.8 weighted formula was found to be more accurate than eleven other EAC formulas tested. This finding was based on the fact that the .2/.8 weighted formula had the lowest coefficient of variation or ratio of standard deviation to the mean [Ref 25:p. 8]. The study's data base included 26 programs which ranged in dollar value from \$700,000 to \$6,000,000 and ranged in duration from 18 months to 10 years [Ref 25:p. 8].

Another AF study that also supports the AFSC's EAC formula, examined 15 contracts (13 Research and Development Contracts and 2 Production Contracts) which ranged in value from

\$600,000 to \$72,000,000 and ranged in duration of 15 months to five years [Ref. 25:p. 8]. This study is unique in that the data were gathered at the intervals of 25%, 50%, and 75% stages of contract completion. Using the AFSC EAC formula, the following results were obtained:

1. At 25% of contract effort, 77% of the contract EAC's fell within +/- 15% of the final actual costs.
2. At 50% of contract effort, 86% of the contract EAC's fell within +/- 10% of the final actual costs.
3. At 75% of the contract effort, 93% of the contract EAC's fell within +/- 8% of the final actual costs [Ref. 25:p. 9].

The results are quite impressive. The AFSC's EAC formula provides the PM with reasonable forecasted final cost information and the lead time necessary to make sound management decisions.

In selecting which EAC formul(s) to use, the PM must keep in mind that they are "quick look" estimates and are not the absolute truth. Conclusions should not be made from numerical performance data without regard to program technical complexity, schedule constraints, and contractor historical performance [Ref. 22:p.4]. A thorough understanding of these factors will help the PM and his staff to make more meaningful assessments about current and predicted program performance. In addition, it will help the PM and his staff to ensure that the declared EAC is based on data which accurately reflect the contract's performance.

Regardless of which EAC formula is used, the PM should ensure that the contractor reported BCWS, BCWP, and ACWP are graphed or drawn out. According to an OSD analyst, the BCWS and BCWP projections must intersect at target cost and completion date. The ACWP must intersect the contractor's EAC at completion. An illustration of this is found in Appendix F. If the PM's projections of these relationships (BCWP, BCWS, ACWP) appear unrealistic, then the accuracy of the contractor EAC is questionable and possibly misstated. This graphing drill is a useful tool for the PM, because it serves to raise a "red flag". According to one EAC expert, "On large contracts, the absolute impact of cost/schedule variances and misstated EACs has greater significance, even if the variances or misstatements are very small percentages of the total contract" [Ref. 23:p. 5].

F. CPR ANALYSIS METHODOLOGY

Having discussed some of the CPR analysis tools, it is equally important to discuss a CPR analysis methodology. As an initial step, the PM and his staff should examine format five of the CPR. The PM should focus his examination on those areas the contractor's problem analysis has identified as principal contributors to significant variances. Second, the PM's staff should validate the C/S performance data in format one of the CPR and determine if the format one data

corroborates the contractor's problem analysis in format five. Third, if the format one validation and format five problem analysis are in agreement, then the PM should proceed with determination of CPR analysis factors (i.e., CV, SV, VAC, etc.) discussed previously in this chapter. If there is a disconnect between the two formats, then the PM should contact his DPRO and request their help in determining the facts. Fourth, the PM or a member of the program's staff should staff sketch or graph out the BCWP, BCWS, ACWP, EAC and BAC elements. The data points on a sketch or graph can be projected out on a straight line basis, thereby permitting the PM to anticipate any tendency towards a cost overrun and a schedule slippage¹⁹ [Ref. 23: p. 5]. Finally, the PM should ask for a second independent assessment of the contractor's performance should his and the contractor's evaluation of future contract performance (EAC) greatly differ. The DCAA can provide the PM with an independent EAC assessment of his program's performance. The PM can coordinate this support through his cognizant CAO.

On a final note, it is recommended that the PM obtain copies of the Air Force Systems Command Pamphlet 173-4, "Guide to Analysis of Contractor Cost Data," dated 1 September 1989.

¹⁹The PM could utilize a CPR data analysis package like Performance Analyzer to assist in graphing out the various elements. CPR analysis software packages will be discussed in greater detail later in this chapter.

This pamphlet provides great instruction regarding the generation and interpretation of cost and schedule analysis information. In addition, the pamphlet is concise, easy to follow, and an overall excellent desktop reference. The PM can inquire about obtaining this pamphlet by writing or calling the Air Force Systems Command. Their address and phone number can be found at Appendix F.

G. EARNED VALUE

The Honorable Donald J. Yockey, as the keynote speaker for the 1991 C/SCSC National Workshop, called for a return to basics in program management. Specifically, he stated,

. . .we need more realism throughout acquisition. .
.realism in our planning, realism in our estimating,
hard-nosed realism at all decision points. Earned
value. . .is one of the best ways I know of to put
realism into the process [Ref. 24:p. 16].

Earned value is central to C/SCSC, and it is an essential part of any PM's "early warning" system [Ref. 24:p. 17]. In addition, earned value offers the PM with a productive, proactive management approach to program cost and schedule control. One of the key questions that the PM should ask regarding program cost, schedule, and performance objectives is: "Are the expenditures of budgeted funds commensurate with the progress being accomplished?" [Ref. 26:pp. 71-72]. Earned value application can provide the answer to the above question.

Earned value is used to quantitatively measure planned and completed work, and it is expressed in dollars. Earned value equates to BCWP; however, without an established baseline plan (BCWS/PMB) there is no foundation for determining earned value [Ref. 4:p. 119]. There are three rules associated with calculating earned value. They are:

1. Performance measurement must occur at the contractor's lowest possible level. For C/SCSC contracts, this means work package level.
2. The contractor's earned value (BCWP) calculation must be accomplished in a manner consistent with the way the plan (BCWS) was originally established. This will ensure that comparisons between BCWP and BCWS have minimum distortion.
3. Once BCWP has been reported on the CPR, no retroactive adjustments can be made by the contractor, except for legitimate accounting errors. [Ref. 4:p. 120]

Earned value measurement is dependent upon the type of method used by the contractor to measure his work progress. As discussed previously in Chapter III, the contractor's internal management systems are evaluated during the validation process. During this process, both the PM and his review team representatives need to gain an understanding of how the contractor intends to measure work progress for in-process work.²⁰ Under earned value management, work that is complete as of the CPR cut-off date earns 100% of its BCWS;

²⁰In-process work refers to that work in progress; yet, not completed by the CPR cut-off date.

while work that has not begun as of the CPR cut-off date earns 0% of its BCWS. The value earned for in-process work as of the CPR cut-off date depends on which method the contractor uses to measure in-process work.

Earned value methods are applied to labor, material, and other direct costs, and are categorized as discrete, apportioned, and level of effort [Ref. 15: p. 16]. In keeping with C/SCSC, apportioned and level of effort should represent only a minimum part of all work; therefore, the majority of the cost accounts should consist of discrete effort work packages [Ref. 4: p. 121]. Despite the kind of effort involved or the method selected by the contractor to measure earned value (BCWP), the contract BCWS must be determined by the same method [Ref. 27: p. 82c].

There are various earned value methods available such as the "0/100" technique, percent complete, milestone method, and earned standards. The first three techniques or methods apply well to engineering or non-recurring type efforts. The final method favors manufacturing or recurring type efforts.

The "0/100" method establishes that work packages earn no value until completed. Therefore, 0% is earned when the package has begun, and 100% is earned when the package is completed. This technique is not a good approach for effort that exceeds one reporting period because it would greatly

distort performance if applied to long work packages [Ref. 15:p. 17].

The percent complete method assigns earned value based upon a subjective estimate of the percent of work completed on the total work package during a reporting period. In order to minimize the subjectivity of this method, the contractor can employ an earned value credit ceiling (i.e., 85% of the total value of the work package) that can be taken prior to work package completion. This method is recommended for use on longer span work packages (i.e., greater than two months) that do not have interim milestones, or where the establishment of interim milestones is so scattered or few in number as to preclude an effective indication of interim performance [Ref. 27:p. 82-0].

The milestone method is quite objective in that all earned value credit is taken when the milestone is achieved.²¹ Milestones are selected based on objectivity, auditability, and stability. This method works well when work packages exceed three or more months in duration [Ref. 4:pp. 122-123].

The final method, earned standards, is quite complex. Earned value is based upon comparison of work package progress to pre-established operation standards. Earned value credit

²¹Milestones are objective indicators or events that indicate a start, stop, or an achievement of a specific stage of an activity at which point earned value credit can be taken.

is not taken under this method in the event of loss or rework. BCWP or earned value credit, can not be taken until MR has been applied and the BCWS is planned for the rework. [Ref. 15:p. 20].

Earned value is a business management tool that the PM can use to help him with his contract performance measurement. In addition, the earned value concept can assist the PM's cognizant Administrative Contracting Officer (ACO) to evaluate progress payment requests. Which earned value method is best, is up for debate. It is the contractor who decides which earned value method to use, nonetheless, the Government PM needs to understand the principles behind the chosen method. Both parties should arrive at an agreement to use an earned value method that will clearly provide valid, objective cost/schedule performance information.

H. MANAGEMENT ACTIONS

As stated previously in this chapter, the Government PM must be proactive in his analysis efforts in order to gain a timely, accurate assessment of the cost and schedule status of his program. This same proactive philosophy must be carried forward into PM management actions when program problems arise. At some point in a program, the Government PM may face a situation in which a contractor is poorly managing a contract and/or is not managing the contract in accordance

with C/SCSC. Under these circumstances, the PM's program is quite vulnerable to additional costs and increased risks. The goal of a proactive PM should be to directly confront "off-track" contractor efforts by taking early action to turn around a sustained, unfavorable trend before it erodes beyond repair. The PM, through his cognizant ACO, has several actions/remedies available to motivate the contractor to improve his contract cost and schedule control efforts.

A useful, initial action is simply to talk with the contractor. Usually a "heart-to-heart" talk with the contractor will be sufficient to straighten out any perceived problems. The PM could also express his concerns to the contractor in writing. The letter is a more formal way for the PM to further communicate his concerns to the contractor.

Government progress payments can be reduced or suspended when contract requirements are not met. If warranted, this method is very effective in getting the contractor's attention. The contractor's CPR provides the ACO with the objective measures he will need to support his progress payment reduction or suspension decision. Often, just the threat of imposing progress payment reductions or suspensions is enough to turn the contractor's efforts around^p. Before imposing this action, the PM and the ACO would be advised to evaluate the contractor's current financial capability. Imposing progress payment reduction or suspension measures on

a contractor with a weak financial condition could exacerbate the contractor's current performance problems [Ref. 28:p. 20].

Another action available to the PM through the ACO is the reduction of the contractor billings and/or reduction of overhead billing rates. The reduction of contractor billings, can be used when it is found that deliverables for which the contractor has already been paid are determined to be unacceptable and payments for these deliverables should be recouped [Ref. 29:p. 60]. The other reduction can be applied "when it is determined that overhead payments to the contractor for day-to-day management of C/SCSC have not been earned and should be recouped" [Ref. 29:p. 60]. Both measures can be effective motivators, however, the burden of proof is on the Government and will probably require a "bottoms-up" or cost account level audit of the contractor's books.²²

A reduction of award/incentive/fixed fee is another remedy the PM can choose to implement through the cognizant ACO. This action can be applied when a contractor is in noncompliance with C/SCSC requirements and it can be shown that C/SCSC was included as a factor in determination of the fee. Linking cost and schedule performance to fees can help motivate contractor ownership of the cost/schedule control

²²A bottoms-up audit refers to a thorough, investigative effort by the Government (such as the DPRO or DCAA) of contractor incurred costs from the cost account level up to the summary level WBS structure.

effort. However, in research and development programs, the Government (depending on the contract type) normally bears all, or a significant portion of the development risk [Ref. 30:p. 365].

Another action available to the PM, is to request through his PMJEG focal point that the contractor's C/SCSC system validation be withdrawn. This action can be imposed when C/SCSC compliance problems arise with contractors whose systems have been previously validated. A C/SCSC validation withdrawal will remain in effect until the contractor compliance problems are corrected and another satisfactory demonstration review is completed.

The PM, through his PCO, can negotiate a reduction in contract price, provide a cure notice, or issue a show cause notice. A reduction in contract price may be pursued when the contractor does not comply with C/SCSC requirements, however, when this tactic is used, the option of progress payment reduction or suspension may not be available [Ref. 29:p. 61]. A cure notice is an effective "attention getter." This notice informs the contractor that the Government considers his C/SCSC compliance problem to be jeopardizing contract performance. This notice will inform the contractor that he has a prescribed amount of time (i.e., timeframe as deemed reasonable and necessary by the PCO) to fix the problem or the Government may move to terminate the contract for default.

The show cause notice is the next step following a cure notice. It will be issued based upon the contractor's failure to rectify the problem(s) addressed in the cure notice by the prescribed "get well date." At this point, the Government is seriously considering termination for default. The Government has the right to terminate for default if the contractor fails to make progress that endangers performance and fails to perform any provision (i.e., C/SCSC management) of the contract [Ref. 31:p. 15-7]. Obviously, this is a measure of last resort.

The management actions previously addressed can be imposed under a variety of circumstances and may be applied either singularly or in combination. Before recommending any punitive management actions against a poorly performing contractor, the PM should thoroughly investigate and understand the contractor's performance problems. If over two review periods, the contractor's corrective action plans have failed to turn around an unfavorable trend of contract cost and schedule performance; then, the PM should take immediate action, using any of the measures previously discussed.

I. PERFORMANCE ANALYSIS SOFTWARE

In order to monitor cost and schedule performance, the Government PM and his staff rely on the contractor's monthly CPR to determine contract progress and status. According to

one management survey conducted by Arthur D. Little, Inc., "most CPR's are received by Government program offices within five weeks after the close of the contractor's reporting period" [Ref. 32, p. III-56]. As part of this survey, at least 64% of the program offices indicated that it took two weeks to complete CPR analysis [Ref. 32, p. III-63]. After interviewing various individuals at a major systems command, more than half of those interviewed indicated that CPR analysis required at least a week to complete.

CPR analysis is not an easy job. Because of the high degree of subjectivity involved, CPR analysis is often more art than science. In order to develop a coherent contractor performance analysis, the PM and his staff must be able to blend statistical analysis with graphical trend analysis. Today's acquisition environment has placed significant challenges before the Government PM. Today, the Government PM's world is characterized by a shrinking availability of staff and a growing demand for greater decision making lead time. More than ever before, the PM needs a software system designed to assist him in performing CPR analysis.

The Government PM should be aware of what software packages are available to assist in cost and schedule analysis. There are a multitude of commercial vendors that have produced program management software; much of this software has been designed with the Defense contractor, not the Government PM,

in mind. One commercial vendor, Dekker, Ltd., offers a fully integrated system for schedule, resource, cost, and performance management. Current DoD clients include various program offices in all three military Services.

The Dekker System, or Trakker Plus, provides an array of project calculations such as CV, SV, SPI, CPI, TCPI, EAC, and many others. Trakker Plus also provides performance analysis reports such as variance analysis, EAC analysis, and BCWS, BCWP and ACWP distribution. The Trakker Plus system also includes an array of performance analysis graphics such as BCWS, BCWP, ACWP distribution, SPI/CPI distribution, SV/CV distribution, and EAC analysis.

The Trakker Plus is compatible with IBM PC XT, AT and PS/2 and has the following computer requirements:

1. 640k RAM
2. MS-DOS 2.1 or higher
3. Hard disk, 20-40 megabytes 28MS access speed
4. Floppy disk 5.25" or 3.5"
5. CGA, EGA, Hercules, or VGA compatible graphics card
6. Printer (laser or dot matrix)
7. Plotter (most popular brands supported)

In terms of user friendliness, Trakker Plus is completely menu driven and can operate with Microsoft Windows. Dekker LTD. also offers a Customer Support Service and a C/SCSC on-site workshop. The support service covers telephone support or questions relative to the Trakker Plus system. The price of this service is \$450 per year with an unlimited number of calls per year [Ref. 33:p. 5].

The Dekker workshop covers setting up the system for a C/SCSC environment. Users are taught system operations and interpretation of standard graphs and calculations. This on-site workshop costs \$6000 [Ref. 33:p. 5].

Another noteworthy analysis software package is Performance Analyzer (PA). This package was developed by Thomas/Ccifera, Inc. with the assistance of the Headquarters, Air Force Space Systems Division, Los Angeles, California. This package was specifically designed to streamline and automate cost and schedule reporting analysis. PA can perform various computations including percent complete by WBS or function, current and cumulative CV/SV, current and cumulative CPI/SPI, VAC, TCPI, EACs using weighted indices, and others. PA displays, prints, and plots graphs that include analysis level trend data. This aspect of PA also provides briefing class charts for the Government PM's use. PA also has automated data transfer (ADT) capability. This feature enables automated data transfer from the defense contractor direct to the PM office. It also provides the PM with real time or near real time program status.

Performance Analyzer supports IBM/XT/AT compatible computers and has the following other computer requirements:

1. 485K RAM (approximately, exact memory depends on the number of WBS elements)
2. MS DOS 3.2 or higher for version 3.1 and up
3. EGA, Hercules, and VGA graphic cards

4. Printer (Epson or compatible, also most Laserjet types)
5. Hewlett Packard 755DA plotter
6. Floppy Drive 5.25" or 3.5"
7. Hayes Compatible Modem for ADT

According to OSD and DSMC, PA is fast becoming the front runner of the contractor data analysis software among many of the Government offices within the U.S. Air Force, Navy, Army, and Department of Energy (DOE). PA comes in a commercial and in a DoD version. According to one OSD analyst, the Government is authorized to give the DoD version to the Defense contractor at no charge [Ref. 10].

Performance Analyzer is also user friendly. The menu driven screens are easy to use for both entering and editing data. PA is also reasonably easy to install, however the user needs to ensure that the commands "Buffers = 20 and Files = 20", are established within the configuration system file root directory. PA assumes the user has a basic understanding of DOS and therefore, does not provide step-by-step procedures for modifying the configuration system file. Finally, PA maximizes productivity because the user can get to work immediately and learn as he or she uses the package. [Ref. 34:p. 50]. Despite PA's many positive features, it still requires someone who is computer literate. According to Rear Admiral Vincent, the Defense Systems Management College Commandant, PA is a solid start. However, further improvements are needed to make it more user friendly [Ref. 50].

The Contract Appraisal System (CAPPS) Module was developed by DAI, Inc. for the Defense Systems Management College (DSMC) as part of their Program Manager's Course. This system was designed to assist DoD PMs and other Government executives with analysis of Defense contractor performance. The package can accommodate any WBS/functional structure required, stresses bottom-line analysis, and provides high-level, summarized cost and schedule information [Ref. 35:p. 1-1].

The Contract Appraisal System has the capability to do various computations such as CV, SV, VAC, CPI, TCPI, and EAC. It executes very thorough variance analysis and provides indicators of major problem areas. For example, CAPPS will provide the following type of indicator narrative:

Actual expenditures through this period are \$31,300,000, which means that to date, the effort is costing more than expected [Ref. 35:p. 6-15].

It also makes extensive use of color and graphical presentations and offers a "zoom" feature. This zoom feature allows the PM to focus on the most current trends by showing the last six months of data versus the total number of months of on file data. This capability is helpful because it provides the PM with greater visibility into BCWS, BCWP, and ACWP relationships [Ref. 35:p. 6-13].

This software runs on IBM PC/XT or compatibles. It will also run on a Zenith 110/120. CAPPS has the following other computer requirements:

1. MS DOS 3.1 or higher
2. 512KB RAM minimum
3. One floppy disk drive (5.25") and one hard drive
4. CGA, EGA, or VGA board
5. Color or monochrome monitor
6. Epson or Hewlett Packard Laserjet printer

The software is very user friendly. It provides the user with both a "Help" function and "Explain" function. These functions provide the user with instruction on the various analysis techniques, explains performance measurement terminology, and gives detailed information concerning software and hardware functions. The CAPPS documentation is easy to read but the installation is cumbersome. For example, the user may need to remove any memory intensive programs from the user's hard drive before installing and running CAPPS. It also has the benefit of allowing the new user to learn how to operate the system in the course of doing actual work.

The Contract Appraisal System, unlike the previous two systems, doesn't allow the user to change any of the performance analysis formulas. In addition, the PM is unable to evaluate more than one contract at any given time, because when a new contract base is entered, any pre-existing contact databases are overwritten. The PM can get around this by

preparing individual disks for each contract in question [Ref. 35:p. 68].

Cost Performance Report EZ was developed by the Air Force Cost Center to do detailed CPR analysis. This package was designed with the analyst in mind, so that they could work at any level of WBS. This software is essentially a Lotus 1-2-3 application, version 2.01. It also has the capability to do several different analysis calculations such as CV, SV, CPI, SPI, and five different EACs. This software will provide cumulative-to-date, six month, three month, and current month calucations for all variance indicies. Unlike CAPPS, the package does not provide indicators of major problem areas. This software has graphical capability as well but the system will not print on a plotter as the other systems previously discussed.

This program works on any IBM compatible PC and has the following other computer requirements:

1. MS DOS 2.0 or higher
2. 640k RAM
3. Dual floppy (5.25") or Winchester hard drive
4. Graphics board within the PC
5. Monochrome or color monitor
6. No specific printer requirements
7. Lotus, version 2.01 [Ref. 36:p. 35]

According to one study, CPR-EZ was not found to be overall user friendly. For example, the PM user must access several screens before the user can print the package's summary report, instead of being able to print the report directly

after viewing it [Ref. 37:p. 55]. This package does have a "help" function that provides excellent explanations on how to operate Lotus 1-2-3 but it does not provide tutoring on analysis [Ref. 37:p. 61]. Finally, CPR-EZ does not permit the new user to get to work immediately. The software documentation instructs the new user to select the "instructions" option when using the system for the first time [Ref. 37:p. 57]. The instructions option provides information about how the system works and it doesn't offer a means to work along with the instructions.

K. CHAPTER SUMMARY

Chapter IV has provided the PM with an understanding of contract cost and schedule performance analysis basics. This chapter addressed the Cost Performance Report, specifically focusing on its format and function. In addition, various aspects of CPR analysis were described and techniques were discussed. Chapter IV also addressed the concept of earned value, and described the various methods in use.

This chapter also discussed management actions in response to adverse contractor cost/schedule performance and/or C/SCSC compliance problems. Finally, Chapter IV exposed the PM to some software packages that are available to assist him in his performance analysis efforts.

Chapter V will focus on the analysis of the cost and schedule control aspects of the Navy's A-12 Avenger Program and examine what impacts this program's termination has had on the DoD C/SCSC environment. Throughout the analysis, the discussion will look at what initiatives OSD and the three military services have undertaken to bring about improvements in their execution of the cost and schedule control process.

V. THE A-12 AVENGER PROGRAM TERMINATION: A CATALYST FOR C/SCSC PROCESS REVIEW AND IMPROVEMENT

A. CHAPTER INTRODUCTION

Chapter V will examine the Navy's A-12 Avenger program termination and analyze how it has affected the C/SCSC environment. Specifically, the chapter's analysis will center on performance management initiatives undertaken by OSD and the three military Services in response to the A-12's termination. Finally, this chapter will discuss some "lessons learned" from the A-12.

B. A-12 BACKGROUND

In 1988, the U.S. Navy awarded a \$4.8 billion fixed-price incentive contract to the contractor team of General Dynamics and McDonnell Douglas Aerospace for the full-scale development of a medium attack aircraft to replace its aging A-6E Intruder [Ref. GAO Report, p. 1]. The new attack aircraft, called the A-12 Avenger, was to incorporate state-of-the-art, stealth

technology. Because of its stealth technology features, the A-12 was managed as a "black program."²³

Because of a favorable December 1989 major aircraft review (MAR), the Secretary of Defense, Mr. Dick Cheney, testified to Congress in April 1990 that the first flight of the A-12 was projected to occur early in 1991. He also declared that the program's full scale development would be finished within the contract ceiling price of \$4.8 dollars. By 1 June 1990 the contractor team advised the Navy of major program cost and schedule problems. Moreover, the full-scale development effort would overrun the contract ceiling by an amount that the contractors could not absorb (i.e., over one billion dollars). Second, a significant schedule slip of one year in the A-12's first flight had occurred [Ref. 40: p. 3].

In July 1990, the Navy investigated the A-12 circumstances to find the facts and resolve A-12 discrepancies. The investigation focused on the cause of the variation between the status of the A-12 program and the presentations made to OSD by the Navy regarding the program during the MAR [Ref. 41:p. 1] In addition, the investigation was to focus on

²³Black programs are those ACAT 1 special access programs that are executed under strict security guidelines. As a result, management oversight of black programs is restricted. The A-12's special access nature of was found by the Beach Report to have prevented the operation of normal program cost and schedule oversight mechanisms within both the Navy and the Office of the USD(A).

accountability, and any changes or improvements needed to ensure that timely information was developed and made available to appropriate officials [Ref. 41:p. 1]. The Beach report established that the Navy was negligent. The Navy had sufficient information to recognize the A-12's cost, schedule, and technical problems as early as June 1988, yet made inadequate use of cost and schedule data. For example, Mr. Beach, the Navy Inquiry Officer, indicated in his report that CPRs, since the first quarterly CPR issued in June 1988, showed developing problem trends such as weight growth, late drawing releases, and tooling problems [Ref. 41:p. 9].

Because of the Beach Report findings, the Secretary of Defense gave the Navy until 4 January 1991 to provide a cogent argument why the A-12 program should not be canceled. On 7 January 1991, it was announced by the Secretary of Defense that the Navy had terminated the A-12 contract for default because of contractor difficulty in executing the contract [Ref. 42:p. 1]. The termination decision was based upon Navy projections that made two assertions. Those projections asserted that the contractor team would overrun the \$4.8 billion contract ceiling price by \$2.7 billion. Second, the A-12's first flight would be delayed by at least two years. [Ref. 42:p. 1]

The A-12's termination has sent out a threefold message to the DoD community. First, program managers are accountable

for cost and schedule control management on their programs. Second, cost and schedule management is so important, that programs that fail to use prudent management practices can and will be canceled [Ref. 65:p. 2]. Finally, that the cost and schedule performance measurement and management process needed improvement.

The A-12 termination's impact on the DoD community has been profound. It has produced the realization that the failures suggested in the Beach Report are not unique to the Navy, and that an "A-12 incident" could have happened just as easily in the Air Force and/or the Army. Most importantly, it has provided the catalyst for both OSD and the military Services to engage in meaningful introspection and evaluation regarding their approaches to the C/SCSC process.

C. USD(A)/DOD INITIATIVES

Perhaps one of the most significant impacts of the A-12's termination was the change of leadership that occurred in the Office of the Under Secretary of Defense (Acquisition). On 12 December 1990, just eight days after the Beach Report's release, the incumbent USD(A), Mr. John Betti announced his resignation. It was asserted that Mr. Betti erred in judgment by relying on general assurances from the A-12 contractors, plus earlier Navy assurances, that developmental costs would stay under the ceiling price [Ref. 43:p. 25]. In addition, it

was suggested that Mr. Betti focused more on the contractors' plans for recovery, than he did on the implications of their actual record of eroding cost and schedule performance [Ref. 41:p. 35].

In all fairness to Mr. Betti, it is also asserted that because of his efforts, the A-12 Investigation was initiated. According to one of his military associates, Mr. Betti, after a walk-through of contractor facilities in the Spring of 1990, noted an apparent lack of tooling and manufacturing facilities. It was Mr. Betti's belief that at this point in the program, the A-12 contractors should have been ready to begin aircraft assembly based upon a December 1990 first flight date. Because of this discrepancy, Mr. Betti immediately initiated an investigation.

Mr. Betti's deputy, Mr. Donald J. Yockey, was selected by the Secretary of Defense to become the new Under Secretary of Defense (Acquisition). Mr. Yockey, both an "expert" on C/SCSC and a fervent advocate of earned value performance measurement, was intent on spreading the word that C/SCSC was a good, common sense business management approach. As the keynote speaker at the 1991 C/SCSC National Workshop, Mr. Yockey carried his message to 641 attendants from both Government and industry. His address emphasized the value of C/SCSC, indicating that it helps both Government and industry to plan programs realistically and maintain clear management

visibility of cost, schedule, and performance. Mr. Yockey's address also emphasized his support to the acquisition community and his determination to discipline and improve the C/SCSC process.

Mr. Yockey has recently instituted a major program RFP and contract review. The review is part of Mr. Yockey's new emphasis on proper up-front planning and a "back to basics" approach with regard to C/SCSC implementation. Mr. Yockey and his staff are selectively reviewing key documents that explain a major program's acquisition strategy [Ref. 24:p. 17]. The review focuses on many aspects including a program's overall acquisition strategy, contract type, SOW, specifications, earned value, fee arrangements, and whether the program is fully funded.

From an earned value standpoint, Mr. Yockey and his staff are ensuring that a major program's C/SCSC provisions provide the PM and senior level management with ample control and oversight information, without getting bogged down with unnecessary, non-value added requirements. For example, since April 1991, Mr. Yockey and his staff have reviewed seven RFP's and two contracts. As a result of this review they have found WBS, C/SCSC implementation, and performance reporting problems. Some problems include the following:

1. Two cases in which WBS levels were too low (below level three). In one situation, there were ten elements at level three, while there were 70 elements

at level four or below. According to one OSD analyst, this creates the potential for excessive variance analysis, because of a multiplier effect [Ref. 10]. Essentially, this variance multiplier effect increases as the WBS levels are lowered. As stated previously in chapter III, CWBS reporting should be at level three or higher except in high-risk or known problem areas. Low CWBS reporting levels erode the PM's ability to focus on current problems.

2. One case in which C/SCSC was inappropriately required on a level of effort contract.
3. One case in which the CPR and C/SSR were required.
4. Two cases in which a PERT-Cost type system was required. According to DoDI 5000.2, Part 11, Section B, "Contractor Performance Measurement," the Government is imposing specific control systems [Ref. 7:p. 11-B-1].
5. Eight instances in which CPR variance analysis levels were fixed with no provision for later adjustment of variance thresholds.
6. One case in which there was a duplication of effort. The contract not only required a CPR, but also required the contractor's internal management report. This internal management report was the document from which the contractor created the CPR. [Ref. 10]

In each case, where Mr. Yockey's staff have found problems with major program acquisition documents, they have worked with the procuring offices to improve the documents and the process that created them. Mr. Yockey has emphasized that he and his staff do not intend to usurp the authority and responsibility of those in charge of managing and overseeing major programs. Nonetheless, he does intend to demonstrate to all concerned that he is very serious about thorough, proper planning for major acquisition programs. [Ref. 24:p. 17]

Mr. Yockey's review initiative is not only aimed at new contracts, but also on-going contracts. Mr. Yockey also intends to tackle the big issue of how to improve the contractor systems that DoD is "living with" today. Mr. Yockey's goal in this regard, is to improve contract cost management, while reducing contractor reporting to minimum essential levels. Through a combined effort of DoD, the military Services, and industry, Mr. Yockey believes that a major "reset" in current contracts can improve contract management, yet reduce current reporting burdens. For example, Mr. Yockey's staff just recently reviewed a current major contract with IBM. After careful scrutiny and evaluation, a major paperwork and dollar expenditure reduction was achieved without any detriment to cost and schedule performance reporting. Essentially, various reports, documents, or other data deliverables that were found duplicating and/or providing no significant value were eliminated. According to one OSD analyst, this elimination resulted in a monthly cost savings to the Government of \$800,000. [Ref. 10]

Undoubtedly, the military Services are not pleased about this intense oversight focus by the USD(A). It is quite possible that many Service PMs and senior level managers view this review initiative as another step toward DoD micromanagement. It is this researcher's opinion that Mr. Yockey's initiative is best described as "micro-watch" versus

micromanagement. Mr. Yockey's goal is not a commitment to manage Service programs, but rather a commitment to make major program managers better business managers.

Another initiative of Mr. Yockey's is to ensure that the contractor surveillance plan and MOA are completed and in place as a condition of Milestone II, Engineering and Manufacturing Development Approval.²⁴ Currently, Mr. Yockey is trying to incorporate this as a requirement of acquisition planning within the DFARS [Ref. 10]. In addition, he intends to make the contract surveillance plan and MOA a specific report item on the Acquisition Strategy Report for ACAT I programs [Ref. 10].²⁵

Mr. Yockey has also resolved the problem of special access regarding black programs. Members of Mr. Yockey's staff, the Deputy Director for Cost Management, Mr. Gary Christle, and another cost management analyst, LTC Bob Reuter, have been cleared for special access programs to conduct independent assessment of contractor cost and schedule performance [Ref. 10]. This measure is in response to a Beach Report

²⁴This initiative directly supports a Beach Report recommendation that calls for the requirement for a detailed surveillance plan in place, and a completed program office/DPRO MOA as a condition of Milestone II approval.

²⁵An ACAT I program is a major program that is designated by the USD(A), RDT&E of more than 200 million dollars, and/or one billion dollars for procurement in 1980 constant dollars [Ref. 7:p. 2-3].

recommendation to "review the operation of OSD-level oversight mechanisms for all ACAT I special access programs, and resolve any shortfalls in oversight due to security requirements [Ref. 41:p. 32]." It is felt that qualifying these two individuals for special access programs is a positive step. This clearance arrangement will fulfill the spirit of the Beach Report's recommendation, however, there are some shortfalls.

First, neither individual is authorized oversight access for the same black programs. By virtue of this condition, the OUSD(A) has limited its flexibility in conducting special access oversight responsibilities. Second, OUSD(A) is not given a "blank check" regarding oversight access to all black programs, current and future. Both individuals in question are only cleared for certain special access programs, not all. The researcher was not able to determine a rationale for this other than security clearance is granted on a "need-to-know basis." Ironically, the Beach Report has suggested that OSD does in fact have a need to know [Ref. 82].

Both individuals should be cleared for the same programs in order to gain greater flexibility in conducting independent cost/schedule performance assessment of special access programs. Obviously, the current OSD arrangement has been improved over what it was previous to the A-12 termination. Nonetheless, it is the researcher's opinion that further "fine

tuning" is in order, so that independent assessment of special access programs is truly effective.

Mr. Yockey is resolved to improve cost and schedule performance management education and training among the acquisition workforce. He is attempting to accomplish this objective in a couple of ways. First, he is sending his own staff to various military commands and schools to conduct seminars on C/SCSC concepts.²⁶ Secondly, Mr. Yockey has established a staff officer position within the Office of Acquisition Policy, Program Integration, and Cost Management. This position is currently filled by an Army Lieutenant Colonel. He has been given the assignment by Mr. Yockey, to review all cost and schedule performance measurement education and training within DoD and find out what training existed and who conducted it [Ref. 41:p. 18].

At Mr. Yockey's direction, his staff officer coordinated the formulation of an Earned Value Review Group. Besides the OUSD(A) staff officer, the group membership includes the PMJEG focal points and representatives from the C/SCSC curriculum at both the Defense Systems Management College (DSMC) and the Air Force Institute of Technology (AFIT). The group's review of DoD C/SCSC education and training has revealed a serious

²⁶In FY 90, Mr. Yockey's staff conducted 20 presentations. The number of presentations tripled in FY 91 and is expected to continue to grow in FY 92.

weakness in terms of earned value education. It was found that earned value was not in the "main stream" of program management.²⁷ For example, one of the review group's findings showed that often a DoD PM's first formal training in contract cost and schedule performance management occurred while attending the DSMC Program Management Course [Ref. 44]. The review group felt that a DoD PM should have iterative cost and schedule management development throughout his or her acquisition career versus receiving formal C/SCSC instruction for the first time at the 05/06 or comparable GS/GM-14/15 acquisition workforce level [Ref. 44].

The review group noted that most of existing DoD C/SCSC and/or cost performance measurement education and training is given at DSMC and AFIT. The two principal cost/schedule courses provided by DSMC are the Program Management Course (PMC) and the Contractor Performance Measurement Course (CPMC). The Program Management Course provides 13 hours of cost and schedule instruction plus six hours of cost and schedule practical exercises. The CPMC provides 35 hours of instruction on cost and schedule related topics. The course focuses on techniques of contract cost and schedule data analysis for the purposes of determining current contract

²⁷This main stream of program management refers not only to the career field of program management, but also to the cost estimating, business, and financial management career fields.

status, identifying performance trends, and forecasting estimates at completion. The CPMC has been attended by more people (approximately 6,500 to date) than any other DSMC course. [Ref. 44]

The Air Force Institute of Technology at Wright-Patterson Air Force Base, Ohio, provides the remainder of the formal DoD cost and schedule instruction. There is a collection of three cost and schedule management courses offered at AFIT: systems 361, 262, and 363. The surveillance of C/SCSC (systems 361) course focuses on the role of the CAO and techniques for performing contractor surveillance. This course has two offerings annually with a class size of 35. Currently the class size is expected to be reduced to 25 in FY 93 and beyond. The C/SCSC (systems 362) course emphasizes procedures used to review contractor systems for determination of compliance with C/SCSC. This course is offered four times annually, with 30 students in each class. The Analysis of Performance Data course (systems 363) is intended to acquaint students with management control systems theory, performance measurement terminology, and the earned value concept. Systems 363 is offered twice annually with a class size of 30.

During the earned value review group's inspection of the currently available DoD cost and schedule management education and training, an interesting condition was noted. The group found that there was a noticeable difference between cost and

schedule course demand and supply. For example, it was found that despite the fact that requests for the Contract Performance Measurement Course at DSMC have at least doubled, annual CPMC offerings have been reduced from ten in FY 91 to seven in FY 92 because of funding constraints. In addition, it was discovered that AFIT was only able to fulfill about 25% of the enrollment requests for its triad of cost and schedule courses, again largely because of funding constraints.

The DoD cost and schedule training and education review group's efforts supported the development and release of three important DoD publications. The first publication, DoDD 5000.52, *Defense Acquisition Education, Training, and Career Development Program*, was published on 25 October 1991. This directive updates both policy and responsibilities associated with Acquisition Workforce Career development. Specifically, this document directs that the USD(A) establish the mandatory and desired education and training, and experience standards for each acquisition position within each functional career field [Ref. 58:p. 2].²⁸ This document also directs the secretary of each military department to establish an Acquisition Career Program Board (ACPB) to advise each Service

²⁸There are seven acquisition functions, 12 career fields, and 14 position categories in the DoD Acquisition, Education, Training, and Career Development Program. Each career field has three career levels: level I (entry), level II (intermediate), and level III (senior).

Acquisition Executive in the management of the career development of both military and civilian personnel within the Acquisition Corps. The ACPB also supports the selection of individuals for the Acquisition Corps [Ref. 58:p. 4].

The second publication, DoD Manual 5000.52-M, *Career Development Program for Acquisition Personnel Manual*, was issued on 15 November 1991. This document outlines the Department of Defense Career Development Program for Acquisition personnel. Specifically, it establishes the education, training, and experience standards for specific acquisition workforce position categories and career fields. It further provides for the certification process of acquisition workforce personnel and also the Acquisition Corps career paths [Ref. 59:p. 1-1].²⁹ This manual also directs that Service Component Heads will ensure that their acquisition workforce members receive, as a minimum, the specified mandatory education, training, and experience. This includes required or desired cost and schedule performance management training and experience. The manual states that the acquisition workforce education, training, and experience

²⁹Certification is a process that determines whether an individual meets all the education, training, and experience standards established for his or her acquisition career field or position, or for membership in a Service Acquisition Corps. Career paths refer to the range of opportunities at each career level and also the optimum pathways for vertical and horizontal movement within a career field.

standards must be met by 1 October 1993, however, standards for critical acquisition positions must be met by 1 October 1992.³⁰ [Ref. 59:p. 1-2]

The third publication, DoDI 5000.58, *Defense Acquisition Workforce*, was published on 14 January 1992. Specifically, this instruction "establishes policy, assigns responsibility, and prescribes procedures and criteria for designating acquisition positions and critical acquisition positions for management of the acquisition workforce and for establishing and managing the Acquisition Corps [Ref. 60:p. 1]." Most importantly, this identifies acquisition positions based on seven acquisition functions and provides for the establishment of DoD functional boards for each of the seven acquisition functions, effective 1 January 1992 [Ref. 60:p. 11]. Each functional board is chartered by the USD(A). These functional boards are charged with providing the oversight of management and program execution of their particular functional area career management programs [Ref. 60:p. 12]. Specifically, each functional board is responsible for certifying annually to the USD(A) the education, training, and experience standards and career paths specified. Each board is

³⁰A critical acquisition position refers to those senior positions (GS/GM-14 and above or military grade 05 or higher) carrying significant responsibility, primarily involving supervisory or management duties in the DoD Acquisition System (i.e., PEO, PM, Deputy PM).

responsible for ensuring that their respective career field is properly developed and implemented, and will make recommendations on the establishment or disestablishment of mandatory courses. In addition, each board will review education and training requirements, allocations, quotas, student attendance, priorities and funding to ensure that the goal of attaining a fully qualified workforce is supported [Ref. 60:p. 12].

The OUSD(A) Cost and Schedule Education/Training Review Group has now become one of the three standing committees for the Business Cost Estimating and Financial Management functional boards [Ref. 44]. Despite the change in status, the group will continue to concentrate a large part of its efforts on cost and schedule performance management education and training improvement, in support of all functional boards. The review group coordinator suggested, that because of the Defense Acquisition Education, Training, and Career Development Program, there is a strong effort at the DoD level to "fence" funding for acquisition education and training, including cost and schedule performance management courses. This effort would serve to make less severe the education and training constraints at both DSMC and AFIT, however, until this effort becomes a reality, shortfalls in cost and schedule performance management education will probably remain.

It is the researcher's opinion that OUSD(A)'s efforts to review and improve cost and schedule performance management education and training is both a good idea and is in keeping with Title XII (Defense Acquisition Workforce Improvement Act) of the National Defense Authorization Act for FY 91. Essentially, Congress has mandated that DoD get the acquisition process (people and training) under control and professionalized. The establishment of the Defense Acquisition Education, Training, and Career Development Program has provided the vehicle to entrench cost and schedule performance management education and training throughout the various Acquisition Functional Area Career Fields. Currently, there is evidence of some degree of mandatory cost and schedule education and/or training programmed for level II and/or level III personnel for ten of the 14 acquisition position categories.³¹ This represents a positive step forward in terms of increasing cost and schedule performance management "literacy" among the acquisition workforce.

The researcher offers two criticisms regarding the current mandatory cost and schedule education and training as

³¹Acquisition position categories are functional subsets of acquisition positions. Examples include program management, PM oversight, contracting, auditing, quality assurance, and business, cost estimating, and financial management.

presently structured. First, there is no evidence of mandatory cost and schedule education/training at level I (GS-5 to GS-7 and O1 to O3 military grades) among any of the 14 acquisition position categories. The cost and schedule performance management educational process should begin at this entry level. Second, many level II and III acquisition position categories do not receive a significant amount of mandatory cost and schedule performance management education or training. For example, contracting level III courses only offer about three hours of cost and schedule performance management training.

D. U.S. ARMY INITIATIVES

In response to the Navy's A-12 Avenger Program termination, the U.S. Army, under the direction of the Honorable Stephen K. Conner, the Army Acquisition Executive (AAE), commissioned a special study group to assess the Army's current cost and schedule management practices and to identify possible improvements. The study was conducted in two phases. Phase I solicited input from senior Army leadership, Army Program Executive Officers (PEOs) and senior Army staff members, resulting in 63 pages of information that was formulated into

ten issue areas.³² Phase II of the study involved identifying an Army expert for each issue area. Each expert was provided the pertinent phase I input for their respective issue area, given the mission to conduct an analysis, and asked to provide their comments.

The study concluded that the Army acquisition community deserved an overall "passing grade" regarding its current cost and schedule management practices [Ref. 45:p. 1]. The researcher was surprised by this finding because he was informed by a Department of the Army official that about two-thirds of the Army's major programs had cost/schedule problems [Ref. 48]. Specifically, the study decided that no additional oversight controls were needed and that the current thrust of the Army acquisition community should continue [Ref. 45:p. 7].³³ In addition, it concluded that PEOs and PMs are the Army's best first line of defense against unfavorable circumstances like the Navy's A-12 Avenger Program.

³²The ten issue areas include: independent assessments, contractor performance data, contracting strategies, realistic estimates, DCMC support, Army Acquisition Corps, responsibilities of program participants, special access program oversight, DAB issues, and other observations [Ref. 45:p. 7].

³³The current thrust refers to improvement in the use of C/SCSC data, using contract strategies better designed to avoid cost and schedule problems, and effective, timely implementation of the Army Acquisition Corps. Also, as part of this thrust, the Army is advocating the use of Performance Analyzer and has distributed it to all PEO organizations and subordinate buying commands.

Nonetheless, the study did call for greater sensitivity to and vigilance of cost and schedule management. The study recommended the implementation of four actions to fulfill this call.

The first recommendation proposed that all PEOs and PMs be required to establish and maintain local reading files. The purpose of the file would be to promote greater awareness of C/SCSC issues and concerns among Army acquisition personnel. The reading file would contain both AAE directed documents and any other documents selected by the individual PEO/PM. From a cost and schedule perspective, the AAE directed documents would include the Beach Report, the A-12 PM's Congressional Testimony, Mr. Gary Christle's Earned Value Analysis Paper, and AAE Policy Memorandums [Ref. 45:p. 12].³⁴

The second action recommended a revision in the language of PEO/PM charters.³⁵ The purpose of this action was to clarify duties and to bring increased focus on a PEO's or PM's responsibility for adequate cost and schedule control management [Ref 45:p. 10]. The third recommendation called for special management of contractor joint ventures [Ref.

³⁴Mr. Gary Christle is the USD(A)'s Deputy Director of Cost Management in the Office of Acquisition Policy and Program Integration/Cost Management.

³⁵The PEO/PM charter is a Memorandum of Understanding between the PEO/PM and his superiors. It defines the PEO/PM's mission and responsibilities, and describes his relationship with other organizations and activities [Ref. 46:p. 2-6].

45:p. 8]. Specifically, the proposal suggested that contractor joint ventures are not the preferred method of Government contracting. This proposal is in response to the USD(A)'s current view on contractor joint venture arrangements. Mr. Yockey does not favor contractor joint ventures because he believes they represent an inherent "command and control" risk. In other words, he is convinced that it is extremely difficult to affix clear responsibility and accountability for contract performance between two prime contractors. As far as Mr. Yockey is concerned, the A-12 Avenger program termination has served to confirm his view. Therefore, it is the researcher's opinion that any future contractor joint venture arrangements will not only be discouraged but will also require justification.

While the researcher can understand this point of view, it is probably not completely realistic. Major cutbacks in defense spending will prompt contractors to opt to join forces in order to share cost and development risks, and in some cases, just to stay in business. While there are risks associated with joint venture arrangements, there are also benefits. For example, some benefits would include strengthening the industrial base and capitalizing on the expertise and talents of both contractors.

The final recommendation proposed the development of an independent program assessment capability at the AAE level

[Ref 45:p. 8]. This capability would involve a team of functional experts to conduct program assistance reviews. The assistance reviews would be structured to provide detailed, on-site analysis and field support. The assistance reviews would be done at the AAE's direction, at PEO request, prior to DAB reviews, in response to a Nunn-McCurdy breach, and/or at periodic intervals [Ref. 45:p. 9].

Mr. Conver approved the implementation of three of the four actions. The independent assessment team idea was not implemented for two reasons. First, it was believed that the assessment team represented an unnecessary layer of oversight micromanagement. Second, Army budget constraints would not support the creation and maintenance of this team [Ref. 48].

Mr. Conver summarized the results of the Army study in an AAE policy memorandum number 91-7 titled, "A-12 Lessons Learned," dated 7 October 1991. Mr. Conver further articulated his concerns regarding cost and schedule management in the September-October 1991 issue of the *Army RD&A Bulletin*. Mr. Conver said that the Army could no longer afford to bail out programs that exceed schedules or overrun budgets. He emphasized that such programs are likely targets for Army, OSD, and Congressional budget cutters [Ref. 49:p. 45]. Mr. Conver also reiterated the value of C/SCSC principles. He indicated that cost/schedule management techniques can help avoid "surprise" program cost and schedule

overruns, but only when those responsible for program management fully understand and pay attention to the information provided in the contractor's CPRs [Ref. 49:p. 45]. Finally, he stressed an enthusiastic commitment to the C/SCSC process by Government PEOs and PMs, not just from the members of their staffs, is the key to successful program cost and schedule control [Ref. 49:p. 45].

It is the researcher's opinion, that the Army's actions in response to the circumstances surrounding the Navy's troubled A-12 aircraft program, are lackluster. The results of the study reflect only an interest in investigating potential acquisition process shortcomings and identifying possible improvements. The recommendations concerning the PEO/PM charters will probably not provide significant improvement in the awareness of cost and schedule issues. Overall, these measures reflect minimal substance and contribute very little to the improvement of cost and schedule management skills.

It is the researcher's opinion that the recommendation not implemented, would probably have provided the greatest payoff. The independent program assessment idea would prove to be a valuable tool for the Army. The program assessment team would provide the AAE with a proactive/objective mechanism to evaluate and confirm a major program's "health" before reaching the scrutiny of the DAB. According to one Department of the Army official, having greater certainty of a program's

cost and schedule well-being, strengthens the milestone review process [Ref. 48]. In addition, this team could also conduct assistance visits for various major programs showing a beginning adverse trend in cost/schedule performance. The team could be tailored to provide the kind of help a given program may require (e.g. surveillance, analysis, cost estimating, etc.).

Despite the potential benefits, the Army Secretariat insists that the creation of its own independent assessment capability cannot be justified given current budget cuts. In addition, the Army also suggests that there is no need for new oversight mechanisms, given that there will be fewer programs to oversee. It is the researcher's belief, that if the Army wants to improve its cost and schedule performance, that it must show greater commitment to that effort.

E. U.S. AIR FORCE INITIATIVES

The U.S. Air Force has long been recognized as the C/SCSC stalwart among the U.S. military Services. As previously discussed in Chapter II, the Air Force was the originator of both the earned value concept and the cost/schedule planning and control specification (the C/SCSC predecessor). The Air Force, unlike the other Services, assesses entry grade officers directly into the program management field. An Air Force officer assessed into program management, is carefully

trained and developed throughout his or her career in cost and schedule management and other aspects crucial to successful program management.

Despite the Air Force's strength in C/SCSC, the Navy's A-12 Avenger Program termination has caused the Air Force to increase its emphasis on cost and schedule management. The A-12's termination struck a nerve within the Air Force, serving as an unpleasant reminder of its own cost and schedule management program problems including the current B-2 Bomber and the C-17 Transport Aircraft programs.

The B-2 Bomber program's cost estimates rose from \$32.7 billion in 1981, to \$70.2 billion in 1989 [Ref. 51:p. 2]. In addition, the B-2's program schedule was delayed each year after the establishment of the program's 1986 baseline [Ref. 51:p. 2]. The B-2 Bomber program was characterized by slow development progress, test and evaluation setbacks, and overruns. In early November 1991, Congress all but "closed the book" on the B-2 by deciding that production would terminate at 15 aircraft versus the 132 originally planned [Ref. 52:p. 50].

The C-17 Transport Aircraft program, in many respects is a mirror image of the Navy's A-12 Avenger program. The C-17, like the A-12, has shown a history of cost growth. The C-17 program began in 1985 with an estimated program acquisition cost of \$34.5 billion. By 1989, the program acquisition cost

rose to \$41.8 billion, a 21% increase [Ref. 53:p. 5]. The C-17, like the A-12, slipped its program schedule. In addition, the C-17 aircraft program has encountered weight problems that will undoubtedly affect the attainment of contract performance requirements. In response to these program developments, OSD and the Air Force have decided to reduce the number of C-17 aircraft purchases from 210 to 120 [Ref. 53:p. 4].

The Air Force's B-2 and C-17 programs represent striking examples of poor contractor program cost and schedule performance. In view of these program performances and the ramifications resulting from the Navy's A-12 Avenger program termination, the Air Force has sought to develop a new approach to program management. This innovative approach is evidenced by the Air Force's F-22 Advanced Tactical Fighter (ATF) Aircraft program.³⁶

As a first step in the F-22 program, the Air Force conducted a prototype fly-off between two vying contractor teams led by Northrop and Lockheed. The Air Force started the competition by informing both teams that each had to invest part of their own money to develop their own ATF prototype.³⁷

³⁶The F-22 incorporates stealth technology similar to that found in the B-2 Bomber and A-12 Avenger.

³⁷Each group eventually received \$818 million dollars in tax funds for R&D, however, each spent roughly one billion dollars of their own money [Ref. 52:p. 51].

In return, the Air Force freed the contractor groups from binding design specifications [Ref. 52:p. 51]. The single contractual requirement for the prototype was for it to take off, fly, and land.³⁸ Freed from rigid Government specifications, each group devised its own design, emphasizing the aircraft performance features of their own choosing.

The Air Force considered this approach viable for two reasons. First, it was believed that rigid specifications would discourage contractor innovation [Ref. 52:p. 50]. Second, if the contractors were to perform some R&D at their own expense, the Air Force then reasoned that the contractors would be motivated to find cost-effective techniques [Ref. 52:p. 50].

As a second step in the F-22 program, the Air Force authorized both contractor groups to decide for themselves how to test or demonstrate their prototype's performance. This aspect permitted a wide open, innovative environment that resulted in two completely different aircraft designs that flew virtually problem free [Ref. 52:p. 51]. The ATF "fly-off" resulted in the award of a sole production contract to the "Lockheed led" contractor group.

³⁸Although the contractors were freed from binding design specifications, their respective prototypes had to meet the Air Force's performance specifications.

The third step of this new approach was to institute a set of comprehensive C/SCSC initiatives. These initiatives included a "flash" report, an integrated product team concept, real-time subcontractor data management, a C/SCSC steering committee, and a management/technical information system (M/TIS).

The "flash" report is a quick look Contract Performance Report (CPR).³⁹ It consists of format one of the CPR and it is due ten working days after the accounting period closes. The data provided in the "flash" report is not audited and is subject to correction in the full team CPR that is due 30 days after the close of the accounting period [Ref. 54]. Despite the fact that the data is not audited, it is satisfactory to provide early insight into potential problem areas. Historically, prime contractor provided cost and schedule data has taken data upwards of two months to be submitted. Subcontractor data has often taken three months to be submitted [Ref. 55:p. 1]. The goal of the "flash" report is to overcome this trend and supply managers with early and timely visibility into potential contract cost and schedule performance problems.

The team concept involves forming integrated product teams (IPTs) at the cost account level. Each team has prime

³⁹Each team consists of two prime contractors and two principal subcontractors that provides "flash" report input.

contractor, principal subcontractor, and Air Force representation. Each team functions like a "mini-program," designed to bring all functional disciplines together. Each team has responsibility for all aspects of assigned program components, ranging from blueprints to cost/schedule and performance aspects [Ref. 52:p. 51]. The IPT approach espouses a philosophy of integrity, logic, and teamwork. For example, IPT leaders are charged to seek consensus versus issuing orders. In addition, IPT members vote on senior level management decisions, with more votes assigned to the "working level troops" than the "flag" rank officers [Ref. 52:p. 51].

Real time subcontractor reporting is provided for all major subcontractors (i.e., there are ten to twelve). Each of these major subcontractor's current month CPR data is incorporated into the same month-end overall team CPR. This arrangement provides two key benefits. First, it ensures "across the board" consistency of month-end data. Second, it improves timeliness of subcontractor reporting thereby creating a real-time data effect [Ref. 54].

The C/SCSC steering committee is chartered to oversee integration/implementation of C/SCSC throughout the F-22 program. The committee is composed of representatives from the prime and each principal subcontractor, DPROs and the ATF system program office. The steering committee is responsible for reporting periodically to the F-22 program senior

leadership. The committee's objective is to ensure that C/SCSC is fully used as a management tool [Ref. 54].

The final C/SCSC initiative involves the introduction of an integrated management/technical information system. The M/TIS is comprised of five subsystems that include an integrated production system, support system, information system, development system, and management system. The M/TIS management subsystem provides integrated program cost and schedule performance information and data analysis capability. The M/TIS is significant because it provides "the glue" for all F-22 program operations. M/TIS links all program participants to a central data base/operation system.⁴⁰

Besides the F-22 teaming approach, the Air Force has also sought to emphasize and reinforce the C/SCSC process by two other means. First, the Air Force Systems Command (AFSC) has reorganized its cost management division. This reorganization has resulted in the inclusion of an analysis branch and the implementation of a cost and schedule management training program. Second, the AFSC commander, LTG Thomas R. Ferguson, Jr., has issued a memorandum, dated 17 December 1990, "Inspector General Report on A-12." This memorandum emphasizes the need to learn from the A-12 program errors.

⁴⁰The M/TIS users include the Air Force, prime contractor, principal contractors, major subcontractors, suppliers, and DPROs/DCMAOs.

It is the researcher's opinion that the Air Force, in response to the A-12 program termination, has made a substantive effort to improve upon its C/SCSC management practices. The ATF acquisition approach principally embodies this effort. The ATF acquisition approach has created a totally integrated management structure that promotes innovation, efficiency, commitment, and teamwork at the lowest program levels. In addition, the "flash" report concept has much merit. A report that can provide integrated, real-time visibility of potential cost and schedule problems is an invaluable management tool. The ATF program bears careful watching by the other services.

According to Rear Admiral Vincent, DSMC Commandant, the Air Force's F-22 program will be closely studied by the acquisition community [Ref. 50]. He also suggested that if the F-22 program results in an overall success, then it will serve as model of efficiency and affordability for future weapon system programs [Ref. 50]. The ATF acquisition approach may seem unorthodox, but success speaks for itself. Unlike the B-2, the F-22 program produced two prototypes that took to the air in about half the time it took for the first B-2 flight [Ref. 52:p. 50]. In addition, the ATF prototypes flew nearly twice as many times in two months as the B-2 did in two years [Ref. 52:p. 50]. Finally, the cost to develop

and fly the first four F-22s was \$3.9 billion versus \$33.2 billion for the first three B-2s [Ref. 52:p. 50].

F. U.S. NAVY INITIATIVES

Because of its A-12 Avenger program termination, the U.S. Navy is "under the gun" to take significant action to strengthen its existing cost and schedule management practices. The Beach Report concluded that the Navy's existing cost/schedule control mechanisms, if properly operated, would have been sufficient to identify the nature and degree of the cost and schedule problems in the A-12 Avenger contract [Ref. 41:p. 33]. The Navy now fully recognizes that oversight and review mechanisms should have worked better in the A-12's case and actions should be taken to ensure these mechanisms work better in the future. Consequently, the Navy has ongoing efforts to revitalize current cost and schedule performance roles, responsibilities, and processes.

Pursuant to the Beach Report, the Navy Acquisition Executive (NAE), the Honorable Gerald A. Cann, chartered a cost performance analysis working group (CPAWG) on 14 March 1991. The CPAWG was given the mission to identify and report recommended actions necessary to revitalize Navy cost performance measurement and analysis [Ref. 56:p. 4]. Specifically, this group scrutinized cost performance analysis

policies, capabilities, and those processes currently in place. They also conducted extensive interviews with PEOs, PMs, and other Navy senior level acquisition executives [Ref. 56:p. 4].

The study group was broken into five process action teams that included cost and schedule performance planning, implementation, analysis, integration, reporting, and independent assessment. As a first step, each team conducted research and analysis within their respective area of concern. The results of the research, analysis, and interviews formed the basis for the findings and recommendations of the CPAWG's draft report dated 4 December 1991.⁴¹

The draft report cited 22 recommendations to improve cost and schedule performance measurement throughout the Navy. These recommendations were organized into four separate, yet mutually supporting management areas. These four areas include leadership commitment, policy guidance, training, and resources.

One key leadership commitment recommendation centers on the formulation of a cost performance analysis (CPA) alert system for all Navy PMs, PEOs, and other senior acquisition

⁴¹This report is not as yet official. All recommendations within this report may be revised pending final review and approval by the NAE.

executives.⁴² The goal of the alert system is to place early management focus on cost and schedule performance indicators. The system is expected to be electronic and it is proposed that it would incorporate a red, yellow, and green assessment criteria. These assessment criteria would be based upon CPI, SPI, and VAC percent. The proposed methodology of the system would be very simple. For example, a yellow alert condition would cause a report to be generated by the PM to his next higher management level. In addition, the yellow alert condition would also result in independent assessment by the DPRO/DCMAO until the condition changed to green. Similarly, a red condition would require the same report transmitted, not only to the next higher management level, but also to the milestone decision authority. This report is expected to resemble a combination format one and format five of the CPR with the inclusion of earned value charts. The report would explain the nature of the problem and highlight a corrective action plan. [Ref. 56:pp. 17-20]

Two other key leadership recommendations would involve the issuance of a cost performance measurement (CPM) expectations policy memorandum and the development of a generic Navy standard for an integrated, real-time program information system. The expectations policy memorandum will probably

⁴²The alert system would focus primarily on significant contracts [Ref. 56:p. 17].

include a directive requiring PEOs and PMs to develop CPM expertise. It also charges them to provide realistic program cost and schedule status, projections, and risk assessment at all formal program reviews. In addition, the memorandum is expected to emphasize greater interaction between on-site surveillance personnel and the PM office. The integration information system development was proposed based on the current success of the U.S. Air Force F-22 Program's M/TIS. The study group believed that a generic, integrated information system would provide uniform, real-time management data, while allowing contractors to develop their own systems. [Ref. 56:pp. 17-20]

From a policy standpoint, the report proposed the establishment of an integrated WBS coordination process. The CPAWG's findings confirmed that there was a frequent tendency at the program office level to develop a cursory program WBS. As previously stated in Chapter III, an inadequate WBS does not support adequate performance management oversight. This process would be focused on the integration of all functional disciplines ranging from program management to contracting. In addition, this process would be coordinated through a central CPM office of the appropriate Systems Command (SYSCOM). This recommendation was based upon the success of Naval Air Systems Command's (NAVAIR) WBS development process. NAVAIR is the only SYSCOM currently using a central CPM office

to coordinate WBS development [Ref. 56:p. 23]. According to the CPWAG's findings, NAVAIR's integrated WBS coordination process has been responsible for the development of very successful program WBSs for many years [Ref. 56:p. 23].

Another key policy recommendation proposes that PMs use their SYSCOM's central CPM office (if available) to help them with the preparation and review of CPM aspects of key preaward program planning documentation such as the RFP. This proposal is in line with Mr. Yockey's initiative to refine key program acquisition documents and is supported by the 9 May 1991 Joint DoD/Industry TQM Report for Program Management on the Cost and Schedule Management Process. This report identified that the preaward process is the most important area in need of improvement [Ref. 57:p. 3.3-1]. As previously addressed in chapter III, early program office planning for cost performance management is a critical pre-requisite to successful cost performance measurement. Many of the CPWAG's interviews support this, however many of those interviewed said that they had inadequate knowledge or experience with CPM at the early planning stages of their programs. Therefore, many said that working through a SYSCOM's central CPM office during the preaward process was vital to the success of the Navy's revitalization effort. [Ref. 56:p. 24]

The CPAWG's report also supported the need for a review of currently existing C/SCSC training. This aspect is also in

line with Mr. Yockey's initiative to evaluate and improve cost and schedule performance measurement education and training. Specifically, the report proposes that the Navy establish a CPM education/training template for its acquisition personnel. The CPAWG's findings showed repeated evidence of deficient program office CPM input during program preaward planning. In addition, it was suggested that many acquisition personnel were unable to participate effectively in CPM implementation and analysis. Frequently, it was found that program office personnel who were functionally responsible for program CPM leadership were often placed in their jobs untrained or poorly trained in the C/SCSC process. [Ref. 56:pp. 27-29]

One major resource recommendation proposed by the report called for the establishment of centralized cost performance measurement organizations within each SYSCOM to provide matrix support. The CPAWG found that there was a considerable difference between SYSCOMs, PEOs, direct reporting program managers, and program offices with respect to staffing and priority for CPM. CPAWG findings indicated that there was evidence of insufficient CPM support throughout the Navy. Those interviewed by the CPAWG indicated that they need and want more CPM support than is currently available. In addition, it was suggested that frequently inadequate CPM resources had prohibited satisfactory CPM implementation and/or analysis. The report proposed that CPM staffing across

the Navy be reviewed, and where insufficient, prioritize staff allocation to ensure adequate support for all programs. Obviously this measure is highly dependent on funding availability [Ref. 56:pp. 30-33].

Another key resource recommendation calls for the distribution of the most current Performance Analyzer (PA) program throughout the Navy. The CPAWG found that there was very little standardization across the Navy regarding the format/content of contract cost and schedule performance analyses. According to the findings, the quality of the various cost/schedule performance analyses varied greatly. The Navy believes that Performance Analyzer (PA) should become the standard, both because of its comprehensive analysis capability and its automated data transfer feature. The CPAWG's report proposes that the NAE direct the Navy SYSCOMs, PEOs, and PMs to give highest priority to funding PA. [Ref. 56:pp. 30-33]

The recommendations contained within the CPAWG's report currently await final review and approval of the NAE. During the group's interviews it was discovered that the Beach Report and the NAE's subsequent actions have significantly increased awareness of the need for effective cost/schedule performance analysis and reporting. It was also discovered during the CPAWG's review that several SYSCOM revitalization efforts were already in progress. For example, NAVAIR has established and

performed an internal CPM and analysis training program for PEOs, PMs and their staffs, and other senior management personnel [Ref. 56:p. 4]. It is the researcher's opinion that the Navy has taken a serious step forward in finding weaknesses in its C/SCSC processes. According to one OSD analyst, "The Navy is coming on like "gangbusters" with regard to C/SCSC [Ref. 10]."

The CPAWG recommendations look promising. The major hurdles to these recommendations are resources and commitment. The Navy will need to devote additional time and resources just to work out the implementing details. This will not be an easy task, given scarce funding resources.

The CPA alert system appears to be a good idea, however it probably will require the incorporation of an expensive and very complicated management system. For the system to operate effectively, it would require an integrated computer system similar to the Air Force's M/TIS, in which all users are electronically linked. It is the researcher's belief that the red, yellow, green alert criteria would be both hard to quantify and standardize. Similar to variance threshold establishment, alert criteria establishment may require periodic adjustment to retain its usefulness as a management tool. Finally, it may be difficult for the Navy to keep its alert criteria system "honest." It is the researcher's opinion that for the system to be fail-safe, it would have to

be automatic. In other words, a computer system and not a human operator, would have to recognize a breach in the criteria by category and then automatically transmit the alert to the next appropriate higher level(s). Overall the system sounds good, but it is felt that the current DAES and SAR procedures appear adequate for use as early warning devices for senior level Navy program management oversight, provided that the problem of special access is resolved. The Beach Report indicated that the existing Navy program cost and schedule management controls were adequate and that they should have identified the A-12 program's cost and schedule problems [Ref. 41:p. 29].

The bulk of the Navy's revitalization plan hinges on increased mandatory CPM education and training. It is the researcher's experience, that in times of scarce financial resources, training and education are among the first to be curtailed. Perhaps the reason for this is that it is difficult to quantify return on investment on education and training. CPM training and education is not sufficient to guarantee program success. However, without it, the likelihood of fielding a quality product on time and within budget, is slim. Therefore, it is the researcher's opinion that the Navy should pursue its goals to upgrade the CPM knowledge and skills of its acquisition workforce.

G. A-12 "LESSONS LEARNED"

One key A-12 "lessons learned" is that there is an "abiding cultural" problem throughout DoD. The Beach Report suggests that this problem has to do with the disinclination of bringing forward and/or receiving from below adverse program news [Ref. 41: p. 35]. The researcher believes that the problem goes beyond this. Specifically, this problem primarily involves the question of ownership of program cost/schedule performance management.

Program cost/schedule performance management belongs primarily to the PM. According to one OSD analyst, in the past, the way we taught cost and schedule performance management to PMs at DSMC was to tell them to "get a good person to manage it for them [Ref. 10]." According to the USD(A), PMs have viewed C/SCSC as "an offshoot, a sidebar, nothing they needed to devote much time to---or even understand very well [Ref. 24:p. 16]." The researcher believes that PMs must become intimately involved with C/SCSC. They must understand what cost performance can do for them and/or more importantly, what it can do to their career. Although cost/schedule performance management belongs only to the PM, he or she alone, as the C/SCSC advocate, cannot be successful. The PM also must make cost and schedule performance management belong to **everyone** else that plays some part in the program's success or failure. This includes the

deputy PM, the program's business/financial manager, program department heads, senior level acquisition management, the contractor, and most important, the Congress/DoD. **All** functional skills (e.g., engineering, logistics, and test and evaluation) in the program management environment must be involved in cost and schedule control management. In addition, **all** senior level acquisition management must be involved in making cost and schedule work.

The Government contractor also shares in the ownership of program cost and schedule control management. It is imperative that the Government contractor take seriously, his responsibility for his program's cost and schedule performance. It is not unreasonable for the Government to expect that the contractor will pursue sound program planning, conduct realistic risk assessment, and implement proactive measures in order to deliver a product that is on schedule and within the contract ceiling cost. Previously discussed programs such as the A-12 and C-17, reflect a clear lack of cost and schedule control commitment and responsible management by the Government contractor. For example, the C-17 contractor continually missed major assembly milestones. This resulted in an eleven month schedule delay [Ref. 53:p. 8]. The GAO report indicated that this was caused by late engineering drawings which, in turn, caused the late delivery of tools and parts [Ref. 53:p. 8]. This report further stated

that these problems still exist and have caused work that was planned to be completed earlier in the assembly process to be postponed [Ref. 53:p. 8]. At the time of the report, the contractor's plans did not address when or how the deferred work would be accomplished. As a result, the GAO report stated that it would be difficult to predict when the C-17's first flight would occur. The researcher feels that this is irresponsible program management on the contractor's part.

Finally, the Congress and DoD also have responsibility for sharing in the ownership of cost and schedule control management within Government acquisition. Neither really supports stable, full funding of programs. In all fairness to the Government PM and the contractor, it is next to impossible to develop a cohesive program development/production plan and then manage to it successfully when funding is incomplete and/or unstable. The 1986 Packard Commission Report suggested that impressive savings could be achieved by eliminating "hidden costs" that program instability brings [Ref. 78:p. 1]. According to a former Government PM, "There is a mindless bureaucracy out there that will rip you off for ten percent before funds are appropriated and you will lose another ten percent to valid, higher priorities [Ref. 77:p. 40]." The researcher believes that both Congress and DoD need to truly get behind the Government PM. If Congress and DoD want effective cost and schedule control in Government acquisition,

then they can't support a program one day, and not support it the next. The answer, although not simple, is clear---fully fund programs with merit and keep its funding stable. Perhaps a way to increase the stability of funding would be to implement biennial budgets.

Another subset of the "abiding cultural" problem is the failure to recognize that there is a problem. From a DoD standpoint, the circumstances leading to the A-12's termination are not unique to the Navy. It is the researcher's opinion that the failures evident in the A-12 Avenger Program can be expected to occur again in a similar fashion---perhaps to another department or U.S. agency. As previously discussed in this chapter, one Service conducted an appraisal of its C/SCSC operations, and despite evidence to the contrary, gave itself a "thumbs-up" regarding its execution of C/SCSC processes.

This abiding cultural problem subset also belongs to the Government contractor. Often, contractors will paint an overly optimistic picture of how they are performing and/or how they will fix program cost and schedule problems. Frequently, this contractor optimism is unwarranted and is the result of sheer ignorance or the refusal to accept the fact that cost and schedule problems exist. This kind of unwarranted optimism was evidenced in both the A-12 and C-17

programs. The researcher can understand a contractor "can do" attitude, but it must be tempered with reality.

Another key "lessons learned" is that the PM should **never** rely on "general assurances" over hard, C/SCSC data. The problems associated with the A-12's program were not new or surprising. Leading indicators (i.e., CPI, EAC, TCPI, SPI) were available at least one year prior to April 1990 when Mr. Betti, the then USD(A), was briefed on the one billion dollar overrun/one year slip [Ref. 43]. How could such unrealistic evaluations of the A-12 program have been given out and believed despite overwhelming data to the contrary? Perhaps, the answer is, in part, the previously discussed problem concerning C/SCSC ownership. Perhaps the answer is also, in part, inadequate C/SCSC or earned value education and training among both DoD and industry. The Joint DoD/Industry TQM Report on the Cost/Schedule Management process called for the urgent need to evaluate and improve cost and schedule management education and training at all levels [Ref. 57:p. 4-12]. One DoD program manager quoted within the TQM report said, "The level of non-training is almost criminal [Ref. 57:p. 3.5-12]."

It is fortunate that OSD has assumed the leadership role regarding cost/schedule performance measurement education and training. The efforts of the OSD Review Group, previously described in this chapter, are laying the ground work for

improved cost and schedule performance measurement education and training for all acquisition position categories within all career fields. However, there are a couple of problems which might hamper the improvement of cost and schedule performance education and training. These problems include time and money constraints.

Today, Government program offices are austere staffed. These offices don't have a lot of flexibility in terms of overlapping expertise. Therefore, losing a cost analyst or some other functional expert for a five to ten day CPM course at DSMC or AFIT is difficult to support. There is, of course, matrix support to help offset program office shortfalls, but even this isn't always adequate. The researcher found that matrix support sections are often understaffed and/or over committed. CPM education and training improvement could be implemented using correspondence materials, but the researcher feels this would not be very popular among the acquisition workforce. It is reasonable to say that the last thing the average person wants to do is to go through a CPM correspondence course during their free time. C/SCSC education and training must be somewhat convenient, otherwise it is unlikely that it will be supported beyond that mandated by DoDD 5000.52, DoDD 5000.52-M, and DoDD 5000.58. Perhaps desired acquisition education and training improvement could be implemented using visiting instruction teams. These teams

could provide routinely scheduled courses on-site at the various buying commands. Program office personnel could then spend part of the work day in class and the remainder within the program office. A variation on this method would be to establish satellite DSMC and/or AFIT campuses at the various commands. The Army Aviation Systems Command in St. Louis, Missouri, has such an arrangement.

Another key problem hampering the improvement of CPM education and training is funding constraints. As stated previously in this chapter, both DSMC and AFIT, in response to budget cuts, are reducing course offerings. In order for OSD's acquisition education and training goals to become a reality, adequate resources will need to be fenced strictly for this purpose. Despite Congress's passing of the Defense Acquisition Workforce Improvement Act, the researcher questions whether the Congressional appropriations will ever measure up to the task.

Another A-12 "lesson learned" focuses on senior level military department and OSD level oversight mechanisms regarding special access programs. The Beach Report noted that, "A critical OSD oversight mechanism, OSD staff review of contractor CPR data, would have focused attention upon the full scale development contract status, but was not employed until March 1990 in the A-12 program due to security concerns [Ref. 41:p. 30]." All military departments in OSD have taken

measures to ensure that program oversight mechanisms are not "side-tracked" in the future because of security concerns or classifications.

Was the decision to terminate the Navy's A-12 Avenger program a good one? It can certainly be said that there were substantial cost and schedule problems, but by terminating the program what else has DoD lost? Doesn't the U.S. Navy still have a mission need for an aircraft like the A-12? If not, then why was the A-12 program initiated in the first place. Strangely enough, the U.S. Navy is currently involved with another contract to replace the faltered A-12 program, the AX Program. The replacement program is expected to cost twice as much as the originally conceived A-12 program and the desired aircraft performance characteristics may have been reduced. In addition, the replacement aircraft is not expected to be fielded for another ten years. Perhaps, despite the cost and schedule problems, the A-12 program termination will have cost the taxpayers more money in the long run. This alone should be an example to exercise prudent business acumen in program management and decisions to terminate programs.

Although much may have been lost in terms of the Navy's A-12 Avenger program termination, perhaps something has also been gained. The Navy A-12 Avenger program has put cost and schedule control management in the forefront of the acquisition community's collective mind. It has sensitized

DoD major program managers to the ramifications of poor program cost and schedule control. In addition, the A-12's termination has provided an incentive to get back to program management basics such as earned value, integrity, and cost realism. Most importantly, it has become a catalyst for review and improvement of currently existing C/SCSC processes.

H. CHAPTER SUMMARY

Chapter V has examined the Navy's A-12 Avenger program termination and has analyzed how it has affected the DoD C/SCSC environment. Specifically, the analysis has centered on the various cost and schedule performance management initiatives undertaken by OSD and the three military Services. Finally, Chapter V has provided addressed both OSD and the military Services' cost/schedule performance management perspectives and has discussed some of the A-12 "lessons learned".

Chapter VI will examine selected aspects of the cost/schedule control management process. The analysis will focus on program preaward activities, C/SCSC validation and surveillance and the CPR. Throughout the analysis, the discussion will offer suggestions for improvement in the cost/schedule control management process.

VI. ANALYSIS OF SELECTED ASPECTS OF THE C/SCSC PROCESS AND SUGGESTIONS FOR IMPROVEMENT

A. CHAPTER INTRODUCTION

Chapter VI will analyze selected aspects of the cost and schedule control management process. The analysis will specifically focus on program preaward activities, C/SCSC demonstration review process, CPR utility, and program office CPR analysis capability. Throughout the analysis, the discussion will offer suggestions for improvement in the cost/schedule control management process.

B. THE PROGRAM PLANNING PROCESS

One of the key preaward activities is the PM's program planning. A great deal of time and effort has been spent in the development of program planning and controlling mechanisms. A few of these mechanisms include C/SCSC implementation, work breakdown structures, schedules, and organization/responsibility matrices. Many program managers make use of these mechanisms and devote considerable time to program planning. Yet, despite their best efforts, many programs continue to face significant problems (e.g., cost and schedule control) which are directly attributable to incomplete and/or inaccurate program planning. The researcher

believes that this condition is, in part, the result of no established, integrated framework or process to guide the PM's program planning activities. The Government PM needs a planning framework to help him manage the planning phase of his program. This planning framework would serve to both eliminate planning uncertainties and help increase the likelihood of program success.

The researcher found, in the course of his research efforts, a program planning process which could serve as a model. This model involves a pre-defined sequence of generic planning steps which are iterative in nature. These steps include:

1. Review/finalize the contract baseline- This refers to review and finalization of all contract baseline documents (e.g., SOW, CDRLS). This is both an essential step in initiating and planning the program.
2. Define overall program approach- This is the identification of the key program participants and the top level flow of work amongst these participants. This serves to facilitate the communication and issue identification process among all concerned.
3. Define discipline approaches- Each discipline is identified in the program structure and a simplified flow diagram of key work steps is prepared. This step also facilitates the surfacing of issues that must be resolved to complete program technical planning.
4. Develop detailed WBS, program organization, responsibilities, and cost collection levels- This involves the iterative development of the WBS and program organization. It also fixes responsibilities and identifies within the contractor's organization, the levels at which cost will be budgeted and cost/schedule status collected.

5. Develop program network/schedules- This step develops the needed correlation of the program WBS, the networks, schedules, and the C/SCSC.
6. Finalize WBS and cost collection structure- At this point issues affecting the WBS and the cost collection structure will surface. Therefore, these will need to be addressed, resolved, and updated prior to establishment of the contractor's cost/schedule control system.
7. Define resource requirements and develop budgets- The contractor should identify labor, materials, and other costs for cost accounts and work packages.
8. Set-up cost/schedule control system- The contractor's C/SCSC is established and reviewed for the initiation of program cost and schedule performance reporting.
9. Define and implement program status process- Describes how the program cost and schedule performance status will be collected and what reports will be generated and who will review them. [Ref. 79:pp. 49-54]

It is the researcher's opinion that this model can be applied by the PM to the planning of all programs. This model clearly defines the overall flow of planning activities and, most importantly, it promotes the iterative development of those activities throughout the program planning process. Finally, this model serves to initiate early, internal program communication that raises, discusses, and resolves key program issues which often lie dormant until well into the program's execution phase.

C. THE REQUEST FOR PROPOSAL

The Joint DoD/Industry TQM Report on the Cost/Schedule management process suggested that a great opportunity for

waste reduction and process improvement fell within the area of preaward activities [Ref. 57:p. 1-5]. It is the researcher's judgement that many poorly performed preaward requirements create future problems affecting cost and schedule management. One key area of concern during preaward is the development of the RFP.

The RFP, as previously described in Chapter III, articulates the program requirements to the prospective contractor. Through the RFP, the Government virtually decides all the characteristics of the program and resultant equipment. According to one senior military officer, the Government designs in the RFP what will be designed by the contractor; therefore, the Government must ensure that quality is incorporated throughout [Ref. 12:p. 5]. It is important to note that often the RFP represents the only significant contract preaward communication between the Government and the prospective contractor. If the RFP is poorly developed, then effective communication between the Government and the contractor may be prevented, resulting in unclear C/SCSC requirements and poor baseline development. One study suggested that because of competition, the Government often fears talking to contractors about the RFP during preaward. The study also went on to say that contractors were equally afraid of providing input about the RFP. Apparently, contractor fear of being non-compliant discouraged comments.

It is important to stress that a contract can be awarded based upon initial contractor proposals, without any discussions or negotiations. Though a good RFP will not guarantee cost and schedule control management success, a poor RFP will likely result in cost and schedule performance problems "downstream."

One key RFP supporting document is the Statement of Work (SOW). As previously discussed in Chapter III, an ineffective SOW exposes the Government to unplanned and unnecessary cost and schedule performance risks. The SOW ultimately becomes the standard for measuring contractor performance effectiveness. Based on the results of a survey of over 2,000 program managers, 61% of the respondents said that the Government did an inadequate job of preparing SOWs [Ref. 62:p. 25]. SOW development represents one of the most difficult, significant tasks performed by the program office in support of the RFP. Unfortunately, SOWs have become too complex, vary in content, and are largely ambiguous. Clear, uniform guidance must be implemented to cause more effective SOW development. SOW guidance should emphasize the need to keep to a systems engineering approach regarding organization and development of SOW statements. The guidance should provide a set of actions and/or directives for SOW development. The researcher believes that the PM should select an experienced individual to lead the SOW development effort and review and approve himself, the final SOW.

The PM also would be advised to ensure that the SOW preparation team be composed of functional experts from each discipline that have taskings in the SOW. This will help to ensure that all potential aspects of the program are considered. The researcher believes that it is imperative that all team members understand the program objectives, acquisition strategies, user requirements, and areas of responsibilities. This will serve to eliminate conflicts and redundancy of effort and "plant the seeds" for cost and schedule performance management ownership. The researcher recommends that the PM direct his team to use the WBS as a tool to develop and manage SOW requirements. The WBS will help to identify cost and schedule program interfaces, areas of responsibility, and provide a framework for integrating total program requirements. The PM is also advised to develop a new SOW versus copying or modifying another program SOW. Between one program and another, there are likely to be differences in program objectives, program scope, contract type, and cost, schedule, and technical risk.

The researcher recommends that the program manager's SOW undergo a final review for consistency and applicability before it is formally released. This action could be undertaken by the program's data requirements review board (DRRB) or a centralized buying command office (e.g., NAVAIR's central CPM office). MIL-HDBK-245B, *Preparation of the SOW*,

strongly encourages using the DRRB for reviewing SOW content.⁴³ According to one article, the U.S. Army has had reasonable success using the DRRB to help review SOWs before formal release [Ref. 63:p. 25]. Whether the PM chooses to use a review mechanism like the DRRB or not, the PM has the responsibility to do the final review/approval of the SOW.

D. CONTRACTING FOR COST/SCHEDULE PERFORMANCE

Frequently within programs there is no clear provision for direct linkage between the contractor's cost and schedule performance and his fee/profit (depending on contract type). It is the researcher's opinion that clearly delineating this relationship in the RFP, will motivate prospective contractors to avoid "buy-in" bidding and, later during contract execution, will keep the winning contractor aware of his cost/schedule performance. Typically, contractor profit (in a fixed-price type contract) or fees (in a cost type contract) are based on a sliding scale (e.g., 60/40 share line) that is

⁴³The DRRB is responsible for reviewing all data requirements for consistency throughout all sections of the RFP. Specifically, the DRRB ensures that the SOW and CDRL are properly cross referenced and that task requirements are in the SOW and data preparation instructions are in the CDRL. [Ref. 63:p. 25]

a function of the final contract cost.⁴⁴ This final cost aspect, because it can seem quite distant, may not likely enter the contractor's daily decision making process as often as it might, were the contractor to receive interim parts of his profit or fee throughout the contractual effort. The researcher recommends that the RFP include a profit/fee arrangement clause that provides for the receipt of interim earned profit/fee based upon the contractor's cost and schedule performance progress. This arrangement could be best structured for any contract type, but particularly best are the fixed price incentive, cost plus incentive fee, and the cost plus award fee contracts. This kind of arrangement would motivate contractors to be more proactive in the management of cost and schedule performance because it would directly link his interim performance to interim potential profit/fee [Ref. 64:p. 21].

⁴⁴This sliding scale, or shareline, is a ratio of cost sharing or savings between the Government and a contractor based upon the final contract cost. For example in an incentive fee contract, a 60/40 share line would indicate that the contractor will receive a target fee increased by 40 cents for every dollar by which the total allowable cost is less than the target cost. It also indicates the potential for a decrease of the target fee by 40 cents for every dollar by which the total allowable cost exceeds the target cost. [Ref. 64:p. 19]

E. C/SCSC DEMONSTRATION REVIEW PROCESS

The C/SCSC demonstration review process is a necessary mechanism for the implementation of C/SCSC for a first time contractor validation. However, the researcher believes that this process is exceedingly long and not as effective as it could be. As stated previously in Chapter III, the demonstration review process begins within thirty days after contract award with a Government implementation visit. Normally, thirty to sixty days later the Government conducts the readiness assessment visit, followed by the demonstration review which occurs within sixty days of completion of the readiness assessment visit. Should the contractor not pass the demonstration review, then a follow-up review will be scheduled (based upon an agreement between the contractor and the review team director) to examine at the contractor's corrective actions. Follow-up reviews will continue to be scheduled until such time that the contractor's system has been completely validated.

According to one matrix analyst, a first time contractor validation may take as long as a year to complete. The analyst went on to say that one of the contractors that she has been involved with has yet to be validated four years later [Ref. 17]. Another source indicated that for one contractor it took seven reviews and 33 months after contract award to get his system validated [Ref. 66:p. 5]. The

researcher feels that this process is inefficient and provides no real incentive for the contractor to get validated (unless the contract type is a cost plus award fee contract).⁴⁵ Theoretically, the contractor could potentially perpetuate this validation review process until the contract is complete. This is unsatisfactory! The whole point of the validation process is to ensure that the contractor's system meets the C/SCSC and thereby provides the Government with reliable, timely contract performance data. If the Government permits the contractor to operate under a nonvalidated system for a period greater than six to nine months, it is questionable whether the Government can be certain that the contractor's system is providing reliable cost and schedule performance data. If this reliability cannot be confirmed, then the Government's ability to oversee and manage the program is difficult at best.

The researcher suggests that the Government eliminate both the implementation visit and the readiness review. It is the researcher's opinion that C/SCSC has become an institution or the "norm" so much so that contractors wanting to do business with the Government should by now understand the process. The burden of preparation for a demonstration review should be placed on the contractor and not the Government. If the

⁴⁵One of the evaluation criteria for the award fee could be timely system validation.

contractor is doubtful that his system is ready to pass a demonstration review, then he should hire a consultant to assist him in that regard. The researcher also believes that any contractor requiring more than one follow-up to a failed demonstration review should be issued a "cure" notice and/or charged in full for every extra follow-up review.⁴⁶

F. CPR UTILITY

The CPR's utility has long been a point of criticism concerning the C/SCSC management process. According to one study, it was found that a large number of Government PMs used alternate means to the CPR for determining cost and schedule status [Ref. 32:p. III-24]. The researcher believes that there are two primary reasons for this attitude among Government PMs. First, the contractor CPR narrative analyses are poor in quality. Second, the CPR is not timely.

Government PMs frequently complain about the quality of CPR narrative analysis (format five) that they receive from the contractor. According to one study, PMs felt that variance analyses were misleading, too vague, and did not identify program impacts. In addition, the study said that PMs believe that the contractor variance analyses tended to be overly optimistic and resembled "legal fiction" [Ref. 57:p. 3.7-11].

⁴⁶To bring this about, the Government will need to state this in the RFP.

The U.S. Army PMJEG focal point believes, in part, that poor contractor variance analyses are perpetuated by the lack of Government feedback concerning his CPR's quality [Ref. 80]. The Army focal point said that he has frequently been asked by contractors whether the CPR is worthwhile [Ref. 80]. According to the focal point, many contractors doubted that the Government PM ever used the CPR [Ref. 80].

In addition to the lack of feedback, the researcher believes that excessive variance analysis is a contributing factor to the poor quality of contractor narrative analyses. According to one survey, many contractors said that because of excessive variance analysis, it required as many as three weeks (after numerical data was available) for them to put together a reasonable narrative analysis [Ref. 32:p. III]. According to one OSD analyst, Government program offices frequently don't manage their data flow. In other words, they don't adjust variance thresholds when no longer meaningful [Ref. 10]. Excessive variance analysis burdens the contractor, often resulting in a contractor narrative analysis that is deemed by the Government PM as "non-useful." The researcher believes that CPR narrative analysis can be improved by both providing feedback to the contractor and by periodically evaluating CPR thresholds so that a manageable amount of narrative analyses are obtained.

The other area of criticism concerning the CPR's utility is its lack of timeliness. A frequent complaint by Government PMs is that the contractor's cost and schedule performance data reported within the CPR is nearly two months old by the time it is briefed to them [Ref. 67:p. 7]. One major program manager at AVSCOM indicated to the researcher that the CPR is a belated management tool. In addition, a deputy program manager from another major program at AVSCOM related to the researcher that the monthly CPR was usually "too little, too late" to assist in effective management. According to one survey, 55% of the Government PMs interviewed were not satisfied with CPR timeliness [Ref. 32:p. III-23].

There are currently measures available to the Government to make the CPR more timely. One way is to implement the Air Force F-22 program's CPR "flash" report idea. As previously discussed in this chapter, the "flash" report has made the CPR data more real-time, resulting in better lead time for program decision making purposes. Currently, about half of the Air Force System Command's program offices are using a "flash" reporting method of one type or another to improve timely visibility of contract cost and schedule status.

A variation on this method is phased submission of the CPR formats. Essentially, this would involve the submission of individual CPR formats to the program office earlier than the

due date for the entire CPR. It is the researcher's opinion that PMS should permit and encourage phased CPRs because it means that the numbers arrive earlier, allowing earlier program management attention.

Another avenue available to the Government PM in order to improve CPR timeliness is to use electronic data interchange (EDI) for CPR submission. Currently, advancements in telecommunications and computer technology have made the analysis and transfer of contract performance measurement data available via an automated data network system. This system provides dynamic, real-time interchange between the Government and the contractor. According to one source, this system allows read only access to the lowest level, dynamic variance analysis, and bulletin board (E-Mail) correspondence for all involved in performance measurement on the program [Ref. 70:p. 169].

On 24 May 1988, a Deputy Secretary of Defense memorandum said that when EDI is included as a requirement in a contract, the American National Standards Institute (ANSI) X12 EDI

Standard Transaction Sets would be used.⁴⁷ The X12 839 transaction set supports the transfer of all CPR formats [Ref. 71:p. 13]. Although transaction set 839 has been approved, it is not expected to be available until December 1992.

G. PROGRAM OFFICE CPR ANALYSIS CAPABILITY

The Joint DoD/Industry TQM Report said that the CPR is not being used or analyzed effectively [Ref. 57:p. 3.7-14]. The study further said that many PMs view the CPR as only a reporting tool versus a management tool. The researcher's research efforts confirmed this. It is the researcher's opinion that this perception may be the result of a lack of time on a PM's part to analyze the data or it may be that many PMs simply do not fully understand the data provided. One researcher interviewed more than 20 Air Force program managers regarding CPR analysis within their program offices. Most of the group interviewed expressed concern that their own offices lacked sufficient capability or expertise to conduct effective

⁴⁷ANSI is the coordinator for all National standards in the United States. In 1979, ANSI chartered a new committee known as the Accredited Standards Committee (ASC) to develop uniform standards for EDI business transactions. The ASC recently approved two EDI X12 transaction sets. They are 806 (project schedule reporting) and 839 (project cost reporting). The X12 translation software standard is integrated into the transaction sets, permitting both the contractor and Government to send and accept cost and schedule information electronically regardless of the computer system at either end.

contractor cost/schedule performance analysis [Ref. 74:p. 15]. For example, many PMs believed that their internal analyses of the contract cost/schedule problems were nothing more than non-value added restatements of the contractor's format five narrative analysis [Ref. 74:p. 15].

Perhaps a major contributor to the ineffective use and analysis of the CPR is a general lack of training and education. As previously discussed in Chapter V, DoD recognizes this fact and is trying to rectify these training and education shortfalls. Various reports such as the Joint DoD/Industry TQM Report have emphasized that the Government PM wants and needs real-time, insightful cost and schedule performance information. Currently, software systems like Performance Analyzer are helpful, however, they are not always easy to use, nor do they provide advice or recommended courses of action to the user. It is the researcher's opinion, that the PM and his staff need to be provided with an interactive personal computer system that not only analyzes CPR data, but also provides the user with a program diagnosis (trend and/or forecasting) and a "what if" capability.⁴⁸

⁴⁸This "what if" feature would permit the PM or a member of his staff to determine the real-time validity of contractor corrective action plans. In other words, the user can run an immediate simulation on the contractor's "fix" and determine if it works.

Sufficient technology and expertise exists for the development of a cost and schedule performance management expert system. This system would greatly enhance the PM's capability to locate cost and schedule problems and forecast trends. In addition, it could provide expert cost and schedule advice and permit the PM and his staff to "what if" various courses of proactive corrective action.

An expert system is a sophisticated decision support system that has a built-in knowledge/rule base and a separate reasoning capability. In addition, the system provides for system/client communication and has the capability to deal with uncertainty. An expert system also has the capability for dynamic growth and tailoring to specific needs. In other words, it is simple to add, delete, or modify both the knowledge base and the rules.

Many microcomputer based expert systems have been built and used in many fields ranging from engineering to medicine. For example, an experienced civilian project manager informed the researcher of an expert project management system that he helped to develop. The system was designed for the management of small scale engineering and construction projects. The project manager indicated that his system permitted him to be proactive. Specifically, his system was able to confirm the validity of "fixes" proposed by his subordinate engineers. The project manager also stated that his system was simple to

use, requiring only the skills of a secretary to operate.

[Ref. 81]

The shortage of time, staff, and CPR analysis expertise within the program office supports the development and provision of a simple to use diagnostic computer system that assists in the analysis of contract cost and schedule performance data. Current software programs don't provide the ease of use or the reasoning capability features that the program office needs and wants. The researcher believes that a cost/schedule performance management expert system should be developed and provided to the Government PM and his staff to assist them in their efforts to oversee and manage their programs.

Currently, RADM Vincent, the DSMC Commandant, is focusing a part of DSMC's efforts to develop and provide for the DoD PM and his staff, a new program management performance analysis software system that is expected to be both interactive and require only novice computer skills to operate. According to RADM Vincent, a comprehensive, user friendly program management software tool doesn't currently exist within DoD that really helps the PM do his or her job. He said despite Performance Analyzer's popularity, it isn't user friendly enough nor are its capabilities sufficient to fulfill all of the PM's analysis needs [Ref. 50].

H. CHAPTER SUMMARY

Chapter VI has examined selected aspects of the C/SCSC process such as preaward activities, C/SCSC demonstration review process, CPR utility, and program office CPR analysis capability. Throughout the analysis, several proposals for future cost and schedule management initiatives were provided.

Chapter VII will provide a thesis summary, conclusions/findings, and answers to the research questions. The chapter will also offer recommendations and suggest areas for further C/SCSC research.

VII. SUMMARY, CONCLUSIONS, RECOMMENDATIONS, AND AREAS FOR FURTHER RESEARCH

A. SUMMARY

The DoD's interest in major program cost and schedule performance has heightened during the past two years. This interest has been sparked, particularly by the concern over the cost/schedule performance problems reflected by the U.S. Air Force's B-2 Stealth Bomber and the C-17 Military Airlift programs, and the U.S. Navy's A-12 Avenger program. Because of reduced defense spending and in view of these programs, the OSD has significantly increased its efforts to bring about more effective cost and schedule control management among DoD's major acquisition programs.

This thesis has provided the major system program manager with an understanding of the importance of cost and schedule performance management. In addition, it has provided the PM with the necessary cost and schedule control management principles and perspectives to allow them to become more effective program cost and schedule performance managers. First, Chapter II furnished the reader with the background regarding the evolution of cost and schedule control management, and an understanding of the organization of C/SCSC and its philosophy. Additionally, this chapter acquainted the

reader with the key DoD organizations associated with C/SCSC policy development and/or implementation.

Chapter III outlined C/SCSC implementation, highlighting the PM's role and the various C/SCSC interfaces throughout the contract award process. Chapter III also described the C/SCSC validation, focusing on the various validation reviews including the demonstration, subsequent, and extended acquisition reviews. Finally, this chapter provided insight into the C/SCSC surveillance plan and the memorandum of agreement between the program manager and the cognizant CAO.

Chapter IV concentrated on contract cost and schedule analysis, PM management actions, and CPR analysis software packages. Specifically, this chapter provided the reader with an understanding of the CPR's format and function, and provided instruction on CPR data analysis tools including the CPI, SPI, TCPI, and EAC. Chapter IV also took the reader through a CPR analysis methodology and discussed several different earned value techniques such as the "0/100," percent complete and earned standards methods. Chapter IV addressed the various PM management actions available to motivate the contractor to improve contract cost and schedule control efforts. Finally, this chapter provided the PM with insight into four software packages which are currently available to assist the program office in its cost and schedule performance data analysis efforts.

Chapter V examined the U.S. Navy's A-12 Avenger program termination and analyzed how it affected the DoD C/SCSC environment. Specifically, this chapter's analysis concentrated on the cost and schedule performance management initiatives undertaken by OSD and the three military Services in response to the A-12's termination. Finally, this chapter also articulated some of the key "lessons learned" from the A-12 termination.

Chapter VI provided an analysis of selected aspects of the cost and schedule control management process. This chapter's analysis focused on program preaward activities, the C/SCSC Demonstration Review process, CPR utility, and the program office's CPR analysis capability. Throughout the analysis, the researcher offered suggestions for improvement to the cost and schedule control management system.

B. ANSWERS AND FINDINGS TO THESIS QUESTIONS

What should the program manager understand to achieve successful cost and schedule control in major acquisition programs and what affect has the Cost Performance Report had on program cost and schedule performance?

This thesis focused on several key cost and schedule control aspects that the DoD major program manager needs to understand in order to achieve effective cost/schedule performance management. First and foremost, the PM must

clearly comprehend C/SCSC and its objectives. The C/SCSC does not represent a management control system. Rather, C/SCSC provides a set of minimum standards that contractor management control systems must satisfy in order to qualify for DoD major program contracts. The criteria do not prescribe a specific contractor system. Specifically, the goal is not to revise existing contractor systems except as necessary to satisfy C/SCSC. According to DoDI 5000.2, Part 11, "Contract Performance Measurement", a contractor system that meets C/SCSC should provide effective, timely, reliable, and auditable information that will enable the major system PM and staff to evaluate contract cost and schedule performance.

Secondly, the PM should understand his role in the C/SCSC implementation process. The researcher determined that activities which occur during the preaward phase affect many later activities during the contract's execution. The preaward process is very important because this is where the PM sets the stage for his cost/schedule control management program. Proactive PM involvement and leadership throughout the various preaward activities can make a significant difference in "downstream" program cost and schedule performance. Various preaward activities that directly impact program cost and schedule management include the development of the statement of work, establishment of variance thresholds, determination of Contract Data Requirements Lists,

and proposal of a contract work breakdown structure. Chapter III, Sections B and C discussed these aspects in detail.

Third, the PM needs to understand the C/SCSC validation process and the importance of establishing a C/SCSC surveillance plan. Validation involves the verification of the contractor's management control system and it represents phase one of the C/SCSC process. This process begins after contract award and continues through contractor system demonstration and acceptance. The validation process includes a series of reviews conducted by a Government review team of selected representatives from the program office and Defense Contract Management Command. The PM needs to ensure that the team is comprised of experienced personnel because they will be the ones who determine whether the contractor's system is adequate.

The surveillance plan establishment is absolutely key to C/SCSC implementation. This plan describes DoD surveillance measures, the review cycle, and organizational responsibilities. As part of this plan, a Memorandum of Agreement is established between the cognizant Contract Administration Office and the program office to ensure that surveillance responsibilities are understood. The lack of a firm surveillance plan and a Memorandum of Agreement can create confusion and result in ineffective C/SCSC surveillance

of a contractor. Chapter III, Section I, discussed C/SCSC surveillance.

Fourth, the PM needs to understand the impact of contractor post-award actions on the program's cost and schedule control management. One of these key actions include the contractor's establishment of his performance measurement baseline (PMB). The PMB represents the contractor's time-phased budget plan for the accomplishment of the contractual effort. The PM needs to ensure that the contractor establishes a detailed PMB as soon as practical after contract award. This has frequently been a problem. Not establishing a PMB early on in the contract (e.g., within four to six months) can result in an early loss of accurate contract performance evaluation.

Equally key is the maintenance of the PMB. A PMB can change frequently throughout the span of the contract. It is imperative to the integrity of cost and schedule performance evaluation that the PM ensure all changes are carefully managed and are traceable to their sources. Chapter II, Sections G and H discuss the establishment and maintenance of the PMB in detail.

Fifth, the PM needs to understand the format and function of the Cost Performance Report (CPR). The CPR is comprised of five formats, is usually prepared monthly by the contractor, and provides structured, summary level cost and schedule information. The PM should be familiar with the CPR's formats

and be aware that the CPR supports the development of other management oversight reports from the program manger to higher authority. These reports include the Defense Acquisition Executive Summary Report and the Selected Acquisition Report. Chapter IV, Section, B, provides a detailed discussion of the CPR.

Sixth, the PM needs to have an in depth understanding of CPR analysis factors, estimates at completion, and earned value methods. These factors include Cost Variance, Schedule Variance, Cost Performance Index, Schedule Performance Index, and the To Complete Performance Index. These factors provide the PM with a good indication of the contractor's current cost and schedule performance. The estimate at completion (EAC) provides the PM with an estimate of cost at completion for the contract. The PM needs to be aware that there are several ways to determine an EAC. Moreover, the PM must keep in mind that EAC's are "quick look" estimates and are not the absolute truth. Conclusions should not be made from numerical performance data without regard to program technical complexity, schedule constraints, and the contractor's historical performance.

Earned value is central to C/SCSC and is an essential part of any PM's "early warning" system. Earned value methods permit the PM to quantitatively determine whether the expenditures of budgeted funds are commensurate with the

contractor's progress. Chapter IV, Sections C, D, E, F, and G discussed these aspects in detail.

Seventh, the PM needs to be aware that there are CPR analysis software tools available to assist the program office in its analysis efforts. Based upon a shrinking availability of staff and a growing demand for greater decision-making lead time, the PM, more than ever before, needs a software system designed to assist him in performing CPR analysis. Chapter IV, Section I provided a detailed discussion of four CPR analysis software packages.

Eighth, the PM needs to understand the importance of implementing proactive management actions when the contractor is poorly managing a contract and/or is not managing the contract in accordance with C/SCSC. The goal of a proactive PM should be to directly confront "off-track" contractor efforts by taking early action to turn around a sustained, unfavorable trend before it erodes beyond repair. The PM, through his cognizant Administrative Contracting Officer and/or Procuring Contracting Officer, has several actions/remedies available to motivate the contractor to improve contract cost and schedule efforts. Chapter IV, Section H, discusses these actions in detail.

Ninth, the PM needs to have an understanding of the impact that contract replanning and reprogramming can have on contract cost/schedule performance management. Both replanning

and reprogramming will affect the performance measurement baseline. It is essential that replanning and, in particular, reprogramming are carefully managed to prevent distortions in cost and schedule reporting. Chapter III, Section H, provided a detailed discussion of the performance measurement baseline change process and provided some basic rules that the PM needs to keep in mind regarding replanning and reprogramming.

Finally, the PM needs to understand how the U.S. Navy's A-12 Avenger Program termination has impacted the DoD C/SCSC environment. The A-12 termination has brought C/SCSC to the forefront of program management and has provided a message to all DoD PMs that they must become intimately involved with C/SCSC. Specifically, PMs must understand what cost and schedule performance management can do for them and what it can do affect their career. Current initiatives taken by OSD and the three military Services to improve cost and schedule performance management will have an impact on future DoD major program management. These initiatives involve improvements in cost/schedule performance management education/training and place a greater emphasis on proper up-front planning and "back to basics" approaches with regard to C/SCSC implementation. Chapter V discussed these initiatives and their implications to major program cost and schedule performance management.

In general, the Cost Performance Report has not had a significant impact on cost and schedule performance management. The researcher found that the CPR was used more as a reporting tool versus a management tool. Additionally, the researcher found that many program managers used alternate means to the CPR for determining cost and schedule status. Two primary reasons for this attitude among PMs include poor quality contractor narrative analyses and a lack of CPR timeliness. There are measures available to the PM to help correct these shortfalls. Some measures to improve narrative analysis quality involve the PM providing feedback to the contractor and adjusting the variance thresholds in order to preclude excessive contractor variance analysis. Some measures to improve timeliness include phased submission of the CPR formats and/or implementing a "flash" reporting system. Chapter VI, Section F, discussed the CPR's utility in detail.

What are the key aspects of the DoD Cost/Schedule Control Systems Criteria (C/SCSC)?

The CPR consists of five formats; format one (Work Breakdown Structure), format two (Functional Categories), format three (Baseline), format four (Manpower Loading), and format five (Problem Analysis Report). Format one provides data for the measurement of contractor cost and schedule performance by summary level WBS elements. Format two

provides information about the same data elements addressed in format one, however, the second format is sorted by the contractor's functional structure versus the WBS used in format one.

Format three provides a summary of the PMB (including changes), undistributed budget and management reserve. Format four, using the same functional categories used in format two, indicates the contractor manpower requirements. Finally, format five provides an analysis summary report of major program problems to date and explains major changes to the baseline. This format also addresses all significant cost and schedule variances which exceed thresholds and includes the contractor's corrective action plan. Chapter IV, Section B, provided a detailed explanation and discussion of all items contained within the CPR.

What is the current policy and practice for validating contractor (cost/schedule) management systems?

The validation process includes a series of reviews conducted by a Government review team of selected representatives from the program office and Defense Contract Management Command. There are varying degrees of validation review application depending upon whether the winning contractor has a previously accepted C/SCSC system. Normally, a contractor with a previously accepted C/SCSC system will

undergo a Subsequent Application Review (SAR) or an Extended Subsequent Application Review (ESAR).

The SAR is a three to five day, informal review which is designed to verify that the contractor's previously accepted system is correctly and effectively applying the C/SCSC on the new contract. A SAR may also be used periodically throughout the span of a contract to "spot check" the contractor's system for C/SCSC compliance. The ESAR usually requires ten days to conduct and is more formal than the SAR. An ESAR is conducted whenever a program has moved from one phase to another (e.g., development to production), whenever a program has been extended, or when a previously accepted system has had significant revisions. In both a SAR and an ESAR, the contractor is expected to be ready to receive the review within 90 days after contract award.

For a new C/SCSC applied contractor system, the validation process is more involved. The process begins within 30 days after contract award with an Implementation Visit. This visit establishes a preliminary dialogue between the Government and the contractor, and lays the groundwork for the Readiness Assessment Review. This review occurs about 30-60 days after the Implementation Visit. Its purpose is to decide whether the contractor's system is ready for the Demonstration Review. This review is a formal in-depth examination of the contractor's management control system for C/SCSC compliance.

Should the contractor pass the Demonstration Review, a formal notice of acceptance will be issued. Should the contractor fail to pass this review, discrepancies will be noted in a formal report and a follow-up review will be scheduled at some future date, mutually decided between the review team and the contractor. Chapter III, Section I, discussed C/SCSC validation in detail.

How does/should the program office/program manager utilize the data provided in the Cost Performance Report?

According to DoD 5000.2-M, Part 20, "Cost Management Reports," the CPR is the principal document used by the Government to measure the contractor's contract performance on a major defense contract. The CPR's intended purpose is to provide the Government PM and program office with the cost and schedule performance status of their program and the impact of any problems. Analysis of the CPR data should permit the Government PM and program office to forecast EAC's and identify any adverse performance trends. This information enables the PM to make informed program management decisions and implement necessary corrective actions to bring about improvements in contractor performance. Chapter IV, Sections C, D, E, and F discussed CPR analysis in detail.

The Government Program Office also uses the CPR to support the development of other reports such as the Defense Acquisition Executive Summary (DAES) and the Selected

Acquisition Report (SAR). Additionally, the CPR is also used to report to Congress whenever the contractor exceeds the 15% and 25% unit cost thresholds prescribed by the Nunn-McCurdy Amendment. The CPR is also used by the Government program office and PM to confirm and quantify problems discovered through DPRO/DCMAO surveillance efforts.

Although the CPR was partially designed as a contract cost and schedule performance management tool, it is frequently used only as a reporting tool by the Government PM. This is directly related to the belief that the CPR has minimum utility as a management tool. Many PMs feel that contractor narrative analyses are of poor quality and that the CPR emphasizes history and current status, but not future planning. Consequently, some PMs sometimes use other means (e.g., contractor internal reports, DPRO input) to augment the CPR in order to better manage their program's cost and schedule performance.

How does the Government determine an appropriate threshold to measure cost/schedule variance?

Variance thresholds are normally applied to the project summary level CWBS elements that are specified to be reported within the contract. There are various approaches available to the PM regarding the determination of appropriate thresholds for measurement and evaluation of contract cost and schedule variances. One method entails establishing a

variance threshold based on a percentage of the BCWS or BCWP and a fixed dollar amount (e.g., \$200,000). Essentially, any cost and/or schedule variance that breaches the threshold percentage/fixed dollar amount would require a contractor variance/narrative analysis for only the top ten or twenty highest cost and/or schedule critical items of the contract. This approach ensures that the PM receives a manageable amount of variance analysis information, yet provides sufficient visibility over the most important cost/schedule performance problems.

It is very important that the PM establish and maintain meaningful variance analysis thresholds throughout the span of the program. Should the PM discover through a periodic review that the thresholds are no longer meaningful or appropriate, then the PM should modify them. It is essential that the PM put provisions for threshold modification capability within the contract RFP, otherwise, it could be construed by the contractor as a constructive change to the contract. Chapter III, Section C, addressed thresholds in detail.

What is meant by rebaselining and what affect does it have on a program's C/SCSC?

Rebaselining refers to contractor PMB replanning or reprogramming. Replanning involves a change in the original PMB plan for accomplishing authorized contractual requirements. There are two types of replanning, internal and

external. Internal replanning results from a need by the contractor to compensate for cost, schedule, or technical problems encountered that have made the original PMB unrealistic. The contractor can internally replan without the Government PM's approval if the contract target cost or estimated cost is not exceeded. Under this condition, there is no change in the scope of the contract. Finally, internal planning can eliminate schedule variances to date, however, cost performance variances will continue to be evident on the CPR because the total allocated budget remains linked to the contract budget base.

External replanning results from Government directed changes or constructive changes to the contract. These kinds of changes will often result in a change in contract scope which will probably mean an increase in the contract target cost or estimated contract cost. The contractor must not change his contract budget base when externally replanning until the contract change is formally authorized by the Government through a contract modification.

Reprogramming, also referred to as over-target baselining, occurs when the total contract budget base is insufficient to cover the remaining authorized work. Under this condition, the contractor will seek relief from his current PMB by requesting Government approval to go to an over-target baseline. A request to go to an over-target baseline is a

formal declaration of an overrun condition. This involves a complete, major restructuring of the contractor's efforts, resulting in a major change to the baseline. Reprogramming results in the resetting of current cost and schedule variances to zero. The variance adjustments are made to each reported WBS element affected and will be entered in column 12 of format one of the CPR. The total of column 12 will equal the amount shown on the variance adjustment line in column 11 of format one of the CPR. By zeroing out previous cost and schedule variances, the PM can maintain clear visibility of the contractor's future cost and schedule performance. Chapter III, Section H, discussed rebaselining in detail.

What are some of the software packages available to the program manager to assist in cost and schedule data analysis?

CPR analysis is not an easy job. In order to develop a coherent contractor performance analysis, the PM and his staff must be able to blend statistical analysis with graphical trend analysis. Currently, there are software packages available to assist the PM and his staff in their CPR analysis efforts. Four software packages were discussed and include Trakker Plus, Performance Analyzer, Contract Appraisal System, and CPR-EZ. Chapter IV, Section I, addressed these software packages in detail.

What are some of the major shortfalls with the C/SCSC process and how might it be improved?

Some of the major shortfalls associated with the C/SCSC process include preaward activities, the C/SCSC demonstration review process, CPR utility, and program office CPR analysis capability. One of the key preaward activities is the PM's program planning. A great deal of time and effort has been spent in the development of program planning and controlling mechanisms such as C/SCSC implementation, work breakdown structures, and schedules. Many program managers make use of these mechanisms and devote considerable time to program planning, yet despite their best efforts, many programs continue to face significant cost and schedule problems that are directly attributable to incomplete and/or inaccurate program planning. Currently, there is no established, integrated framework or process to guide the PM's program planning activities.

A planning framework would serve to eliminate planning uncertainty and help increase the likelihood of program success. An example of such a framework is contained in the following sequence of steps:

1. Review/finalize contract baseline.
2. Define overall program approach.
3. Define discipline approaches.

4. Develop detailed WBS, program organization, responsibilities, and cost collection levels.
5. Develop program network/schedule.
6. Finalize WBS and cost collection structure.
7. Define resource requirements and develop budgets.
8. Set-up cost/schedule control system.
9. Define and implement program status process.

Chapter VI, Section B, discussed this framework model in detail.

The RFP development is a key area of concern during preaward. Through the RFP, the Government virtually decides all the characteristics of the program and resultant equipment. Therefore, a poorly developed RFP may create future problems affecting cost and schedule performance management. Frequently, because of the "rules of competition," the Government is hesitant to communicate during preaward with the prospective contractor about the RFP. Similarly, the prospective contractor is discouraged from providing feedback about the RFP because of a fear of being found non-compliant. Consequently, effective communication is prevented between both parties, frequently resulting in unclear C/SCSC requirements and a poorly developed baseline. A draft RFP is a good way to stimulate dialogue and diffuse problems up-front in the program planning period.

One key supporting document is the SOW. The SOW ultimately becomes the standard for measuring contractor performance effectiveness. Therefore, an ineffective SOW can expose the Government to unplanned and unnecessary cost and schedule performance risks. SOW development guidance is needed to emphasize a systems engineering approach. In addition, this guidance should provide a set of guidelines and/or directives for SOW development. A final review of the SOW by a program review board (e.g., DRRB) for consistency and applicability is a must before formal release. Chapter III, Section B, and Chapter VI, Section B, discussed the RFP and SOW.

Frequently there is no clear provision for direct linkage between the contractor's cost and schedule performance and the contractor's fee/profit (depending on contract type). Clearly defining this relationship in the RFP can motivate prospective contractors and avoid "buy-in" bidding and, during contract execution, keep the contractor's cost and schedule performance "on track." The RFP should contain a profit/fee arrangement clause that provides for the receipt of interim earned profit/fee based upon the contractor's cost and schedule performance. This arrangement could be structured for any contract type, but particularly for fixed price incentive, cost plus incentive, and cost plus award fee contracts. Chapter VI, Section D addressed this aspect in detail.

The C/SCSC demonstration review process is exceedingly long and not as effective as it could be. Since contractor follow-up reviews continue until such time as the contractor's system is validated, theoretically, a contractor could potentially perpetuate this validation process until the contract is complete. This process does not provide adequate incentives for the contractor to pass validation requirements.

The Government should eliminate the Implementation Visit and the Readiness Review Assessment. Also, any contractor requiring more than one follow-up review should be issued a "cure" notice and/or be charged the cost to the taxpayers for every extra follow-up review required. Chapter III, Section I, and Chapter VI, Section E, discussed this review process.

CPR utility has been a point of criticism concerning the C/SCSC management process. Many PMs believe that the contractor's CPR narrative analyses are inadequate and they believe that the CPR is not timely. A major contributing factor to the poor narrative analysis is excessive variance analysis brought about in part, by inadequate or poorly established variance thresholds. The CPR narrative analysis could be improved by both providing feedback to the contractor and by periodically evaluating CPR thresholds to ensure the PM receives a manageable amount of narrative analyses.

Because of the CPR's lack of timeliness, many PMs don't use the CPR as a management tool. There are various measures

available to the PM to make the CPR more timely. Some examples include phased submission of the formats, a "flash" type report, and electronic data interchange. By making the CPR more timely, the CPR can become a more proactive management tool. Chapter VI, Section F, addressed CPR timeliness in detail.

A Joint DoD/Industry TQM report indicated that the CPR is not being used or analyzed effectively. It is possible that the CPR is not used or analyzed effectively because PMs and their staffs may lack time to adequately analyze the data provided. It is also possible that program offices have low CPR analysis expertise, and do not fully understand the CPR data provided. A major contributing factor to the ineffective use of the CPR is a general lack of education and training. Also, there is not a comprehensive, user friendly, interactive cost/schedule performance analysis software system yet available to assist the program office's management efforts. A tailored expert system could provide the PM office with the needed analysis capability. DSMC is currently working to provide the PM and his staff with a new program performance analysis software system that is both interactive and "user friendly." Chapter VI, Section G, discussed the program office staff's CPR analysis capability and a proposed cost/schedule control management expert system.

What impact has the Navy's A-12 Avenger program termination had on the DoD C/SCSC environment and are there any applicable lessons learned?

The termination of the Navy's A-12 Avenger Program has put cost and schedule control management in to the forefront of the acquisition community's collective mind. Specifically, it has sensitized DoD major program managers to the ramifications of poor program cost and schedule control and it has provided an incentive to get back to program management basics. Finally, it has become a catalyst for review and improvement of currently existing C/SCSC processes among OSD and the three military Services.

From an OSD standpoint, the A-12 termination has indirectly brought about a change in leadership in the USD(A)'s office. The former USD(A), Mr. John Betti, resigned shortly after the A-12 Administrative Inquiry (Beach Report) and was replaced by his deputy, Mr. Donald Yockey. Mr. Yockey, in response to the A-12 termination, has called for a return to proper up-front planning and a "back to basics" approach to program management. In addition, Mr. Yockey has emphasized the need to review and improve DoD cost and schedule control (earned value) management education and training, and has created a staff position within his office to specifically focus on these issues.

Mr. Yockey's education and training review efforts have revealed shortfalls in earned value education which include both course content and course funding resources. These shortfalls are currently being addressed at the OSD level. In addition, Mr. Yockey's review efforts have contributed to the development and publication of three DoD publications which are focused on DoD acquisition education, training, and career development. Chapter V, Section C, addressed these publications and OSD initiatives.

The U.S. Army's reaction to the Navy's A-12 Avenger Program termination has been to conduct a study. The purpose of the Army study was to assess its current cost and schedule management practices and to identify possible improvements. The study resulted in the development of recommendations and resulted in the implementation of three initiatives. Chapter V, Section D, discussed these initiatives in detail.

The U.S. Air Force response to the A-12 Avenger Program termination has primarily centered on an innovative approach to acquisition management which it has implemented through its F-22, Advanced Tactical Fighter Aircraft Program. The principal focus of the Air Force's approach has been to develop integrated, real-time information and management tools in support of program cost, schedule, and technical performance. Potentially, the F-22 approach could become a

role model for other future DoD acquisition programs. Chapter V, Section E, discussed Air Force initiatives.

Since the A-12's termination, the U.S. Navy's cost and schedule control management review and improvement efforts have centered around its Revitalization Plan. The major thrust of the plan is to upgrade policies, procedures, education, and training to bring about a comprehensive improvement in the Navy's cost and schedule control management practices. The focal point for this plan, the Cost Performance Analysis Working Group, identified 22 recommendations to revitalize cost and schedule performance management. The Revitalization Plan's recommendations are currently awaiting final approval by the Navy Acquisition Executive, Mr. Gerald Cann. The Navy's Revitalization Plan was discussed in detail in Chapter V, Section F.

Chapter V, Section G, addressed some key "A-12 lessons learned." One of these lessons involves the recognition DoD-wide of an "abiding cultural" problem. This problem refers principally to the question of ownership of program cost and schedule management. Essentially, the PM owns cost and schedule performance for his or her program, however, that ownership must be shared by other "players" who have a stake in the program's success. Some of these other players include the program office staff management, senior level acquisition managers (e.g., PEOs), the contractor, Congress, and DoD.

Another key "lesson learned" involved the PM's reliance on general assurances from the contractor over hard, C/SCSC data. Unrealistic evaluations of the A-12's program were given out and believed, despite overwhelming data to the contrary. It is surmised that this condition was the result of inadequate C/SCSC or earned value education. OSD has taken on the leadership role regarding C/SCSC education/training, and is focusing part of its efforts to bring about improvement in cost and schedule management education and training.

C. RECOMMENDATIONS

DoD should institute a provision in the RFP that requires the contractor to submit earned value charts or graphs as part of the monthly CPR.

These charts or graphs would provide a simplified "quick look" at the contractor's performance versus his performance measurement baseline. Frequently, PMs complain about the CPR's utility because contractor narrative analyses is believed to be misleading and/or overly optimistic. Additionally, PMs do not always have sufficient time to review and/or analyze a CPR. The earned value charts or graphs would provide the PM and his staff with a valuable tool that would help them spot program cost and schedule performance trends and problems. In addition, these graphs or charts could also help the program office verify the quality of the contractor's

CPR and qualify the contractor's optimism through comparison with the PM's own statistical charts and forecasts.

DoD needs to establish a generic, integrated program planning framework to assist the PM in his program planning efforts.

Inaccurate and/or incomplete up-front PM program planning is often the culprit behind "downstream" contract cost and schedule problems. Consequently, the PM needs a generic, integrated planning framework that helps him clearly define the overall flow of program planning activities. The framework should be constructed such that it promotes the iterative development of the program planning activities throughout the program planning process. A planning framework of this type will serve to initiate early, internal program communication and eliminate planning uncertainties, thereby increasing the likelihood of program success.

The PM needs to utilize a draft RFP.

The Government virtually decides all the characteristics and success of a program through the RFP. Because a contract can be awarded based upon initial contractor proposals, without discussions or negotiations, a poorly written RFP that doesn't clearly articulate the PM's program needs can often translate into cost and schedule performance problems downstream. A draft RFP is a useful tool because it can promote contractor/Government communication. This

communication helps to both clarify RFP requirements and identify RFP shortfalls which could potentially contribute to program cost and schedule performance problems.

DoD needs to mandate that PMs include a contract clause in the RFP that provides for the periodic review and adjustment of CPR variance thresholds.

This measure gives the PM flexibility to change unmeaningful variance thresholds without resorting to a constructive change to the contract. Variance thresholds which result in excessive variance analysis can create an unmanageable condition, potentially resulting in ineffective Government oversight of the contractor's performance. Secondly, it forces the PM to stay cognizant of his program thresholds. It is a mistake to assume that every PM with some experience knows the correct variance thresholds to apply for the duration of a contract.

The PM needs to use a review group such as the program's Data Requirements Review Board (DRRB) to review the SOW for consistency and applicability before it is formally released.

The SOW is a major supporting document for the RFP, therefore, a poorly developed SOW may expose the Government to unplanned an unnecessary program cost and schedule performance risk. Frequently, the leadership for SOW development is delegated to an inexperienced program office member. In addition, when a SOW development team is used, it is possible

that members of the team do not clearly understand program objectives, acquisition strategies, user requirements, or areas of responsibility. In both instances, an inadequate SOW may result. A final review with a DRRB will provide a necessary quality check, along with close PM involvement.

DoD needs to require that a program's RFP include a profit/fee arrangement clause that provides for the receipt of interim earned profit/fee based upon the contractor's cost and schedule performance progress.

This kind of arrangement would motivate contractors to be more proactive in the management of cost and schedule performance because it would directly link his interim performance to interim potential profit/fee. This arrangement could be structured for any contract type, but particularly for fixed price incentive, cost plus incentive fee, and cost plus award fee contracts.

DoD needs to eliminate both the Implementation Visit and the Readiness Review Assessment from the demonstration/validation review process. In addition, DoD should state in the RFP that contractor's requiring more than one follow-up to a failed demonstration review will be issued a "cure" notice and/or charged the cost to the taxpayer for every extra follow-up review.

The current demonstration review process requires too much time to complete, is inefficient, and does not provide a

serious incentive (except in the case of a cost plus award fee contract) for the contractor to pass validation. It is not unusual for first time contractor validations to require as long as a year to complete. As a result, the Government's ability to oversee and manage the program becomes difficult at best with non-validated information.

DoD needs to mandate use of a "flash" reporting system or phased submission of the CPR formats.

A frequent criticism of the CPR is its lack of timeliness. PM's want and need real-time contractor cost and schedule performance information in order to effectively oversee and manage their programs. Using a "flash" report or a phased submission of the CPR will greatly improve the CPR's timeliness. As a result, this improvement should prompt earlier PM attention to program cost and schedule problems.

DoD needs to continue development and provide the PM with a Cost/Schedule Performance Management Expert System.

The shortage of time, staff, and CPR analysis expertise within the program office supports the continual development and provisioning of a "user friendly," diagnostic computer system that assists in the analysis of contract cost and schedule performance data. Current DoD software programs do not provide the ease of use or reasoning capability features that the program office needs and wants, in order to be comfortable with daily use of such automation. A

Cost/Schedule Performance Management Expert System could provide the PM user with a program diagnosis (trend and/or forecasting) and a "what if" feature. In addition, this kind of system has the capability for dynamic growth and tailoring to specific program office needs.

D. AREAS FOR FURTHER RESEARCH

Further research should focus on the tracking and continued developmental details of a cost/schedule performance management expert system. The research should investigate what elements are presently available and should be contained in such a system by surveying program managers. This research could also explore alternative developmental approaches such as a non-developmental item, expansion of a current system (e.g., Performance Analyzer), or new system development.

Further research could also focus on the feasibility of developing a uniform, DoD C/SCSC desk reference guide. The researcher discovered that many CPR analysts and business/financial managers desired such a guide. This research could determine the best mode for the guide, (e.g., a book format or a set of floppy disks). Additionally, this research could develop the content and structure of the guide, as well as determining a guide proponent within DoD.

Future research could also involve case study analysis of the U.S. Air Force's F-22 program. The research should focus

on this program's approach to cost and schedule control management and determine its suitability as a role model for future DoD programs. The research could generate a cost and schedule "lessons learned" for the DoD program managers.

APPENDIX A

DEFINITIONS

Actual Cost of Work Performed (ACWP)- The cumulative actual costs (direct and indirect) of work accomplished as of the reporting cut-off date listed by each work breakdown structure element [Ref. 83:p. B-3].

Apportioned Effort- Effort that by itself is not readily divisible into short-span work packages; however, is related directly to the performance of other work [Ref. 15:p. 57].

At Completion-Budgeted- The total budget identified to each work breakdown structure element (including any contract changes, application of management reserve, or internal replanning [Ref. 15:p. 57].

At Completion-Variance- The difference between the Budgeted Cost at Completion and the Latest Revised Estimate [Ref. 4:p. 503].

Bottoms-up audit- A thorough, investigative effort by the Government of contractor incurred costs from the cost account level up to the summary level WBS structure [Ref. 10].

Budgeted Cost of Work Performed (BCWP)- The sum of the budgets for completed work packages and completed portions of open work packages, plus the appropriate portion of the budgets for level of effort and apportioned effort. Also known as earned value [Ref. 4:p. 504].

Budgeted Cost of Work Scheduled (BCWS)- The sum of the budgets for all work scheduled to be accomplished within a given time period [Ref. 4:p. 504].

Buy-in- Submission of an offer by a contractor, usually substantially below estimated cost, with the expectation of winning the contract [Ref. 83:p. B-13].

Contract Budget Base- The sum of the current target cost and the estimate of authorized, unpriced work [Ref. 83:p. B-19].

Contract Data Requirements List (CDRL)- A listing of data requirements specified for a contract [Ref. 4:p. 505].

Contract Target Cost- The negotiated estimated cost excluding profit or fee [Ref. 4:p. 505].

Contract Target Price- The negotiated estimated cost including profit or fee [Ref. 4:p. 505].

Contract Work Breakdown Structure (CWBS)- The contract's product-oriented family tree of hardware, software, and services that organize and defines the product in accordance to the statement of work. It is the basis for collecting and correlating schedule, budget, cost, and performance measurement [Ref. 15:p. 58].

Cost Account- An identified management control point at which actual costs can be accumulated and compared to budgeted cost for work performed. It represents the work assigned to one responsible organizational element on the contract work breakdown structure [Ref. 4:p. 505].

Cost Performance Report- A Department of Defense management report generated by the contractor and utilized by a project manager to manage cost and schedule status on major (or significant) contracts [Ref. 4:p. 505].

Cost/Schedule Status Report (C/SSR)- A Department of Defense management report generated by the contractor and utilized by a project manager to manage cost and schedule status on non-major contracts [Ref. 4:p. 507].

Cost Variance (CV)- The difference between the Budgeted Cost of Work Performed and the Actual Cost of Work Performed [Ref. 4:p. 507].

Critical Path- The longest event path in time throughout the program. Any slippage of an activity or event on the critical path will impact program completion [Ref. 15:p. 60].

Demonstration Review- An in-depth examination of the contractor's management control system, designed to ascertain whether the contractor's system complies with C/SCSC criteria and is being used [Ref. 6:p. 5-3].

Estimate at Completion (EAC)- Actual direct and applied indirect costs of a contract to date, plus the estimate of costs for authorized work remaining [Ref. 4:p. 509].

Extended Applications Review (ESAR)- A formal review performed in lieu of a full C/SCSC demonstration when contractor conditions have changed, i.e., when programs change from one phase to another, when contractors move from one facility to another, or when contractors make significant changes to their C/SCSC systems description [Ref. 4:p. 510].

Focal Point- Major command responsible for facilitating the appropriate application and implementation of the C/SSR, through policy and procedural guidance and assistance to the PM, procuring contracting officer, and the administrative contracting officer [Ref. 6:p. 4-1].

General and Administrative (G & A)- Indirect costs incurred in the general management of the company, not related to product output [Ref. 4:p. 511].

In-process work- Work in progress; yet, not completed by the CPR cut-off date [Ref. 4:p. 121].

Latest Revised Estimate (LRE)- The total dollar value of work to date plus the contractor's estimate of the cost for work remaining listed by work breakdown structure element [Ref. 15:p. 61].

Level of Effort- General or supportive type work which cannot be associated with a definable end product and is unable to be controlled by time-phased budgets [Ref. 15:p. 61].

Management Reserve- The portion of the contract budget base that is held for management control purposes by the contractor to cover the expense of unanticipated program requirements [Ref. 15:p. 61].

Management System Description- A formal written documentation of the contractor's data development process, identifying such aspects as baseline development, periodic control cycles, and baseline changes [Ref. 6:p. 5-1].

Milestones- Objective indicators or events that indicate a start, stop, or an achievement of a specific stage of an activity at which point earned value credit can be taken [Ref. 15:p. 61].

Non-major contract- A research, development, test, or development, test, or evaluation contract with a value of less than \$60 million, or a procurement contract

with a value of less than \$250 million (in fiscal year 1990 constant dollars). Also referred to as a less than significant contract [Ref. 7:p. 11-B-2].

Performance Measurement Baseline (PMB)- The time phased budget plan developed by the contractor against which project performance is measured [Ref. 4:p. 515].

Progress Payments- Payments made to a prime contractor, normally on a fixed-price type contract, on the basis of a percentage of his incurred costs [Ref. 4:p. 517].

Project/Program Manager (PM)- The person (Government or contractor) who is assigned the prime responsibility for the overall management of a development/acquisition project/program [Ref. 4:p. 517].

Readiness Assessment- A meeting or series of meetings by selected members of the customer C/SCSC review to a contractor's plant, to review contractor plans and progress in implementing C/SCSC in preparation for a full demonstration review [Ref. 6:p. 5-3].

Reprogramming- The baseline rebudgeting activity which occurs when the contractor formally notifies the PM that the Total Allocated Budget must exceed the Contract Budget Base. Essentially, it is a recognition by the contractor of a contract overrun [Ref. 15:p. 15].

Request for Proposal (RFP)- A soliciatation document used to request proposals from potential contractors [Ref. 83:p. B-95].

Schedule Variance (SV)- The difference between the Budgeted Cost for Work Scheduled and the Budgeted Cost for Work Performed [Ref. 4:p. 519].

Significant Variances- Those differences between planned and actual performance which require further review, analysis, or action [Ref. 4:p. 519].

Statement of Work- That portion of a contract which establishes and defines all non-specification requirements, either directly or by cited documents [Ref. 83:p. B-95].

Subsequent Application Review (SAR)- Visit by Government personnel to a contractor's facility to determine whether the contractor has properly applied the management control system

previously accepted as meeting the requirements of C/SCSC to a new contract [Ref. 6:p. 7-1].

Surveillance Plan- A document that establishes the procedures for accomplishing C/SSR surveillance [Ref. 6:p. 5-5].

Thresholds- Monetary or time reference points determined by the government project manager to track contract progress, which if breached, require analysis by the contractor [Ref. 4:p. 521].

Undistributed Budget- The amount of budget applicable to the contract which has not been identified to work breakdown structure elements at or below the reporting level [Ref. 4:p. 521].

Work Breakdown Structure- A family tree division of hardware, software, services, and project tasks which organizes, defines, and graphically displays the product to be produced, as well as the work to be accomplished to achieve the specified product. Also called the contract work breakdown structure [Ref. 4:p. 522].

Work Packages- Detailed short span jobs, or material items which have assigned budgets for accomplishing the work required to complete the contract [Ref. 4:p. 522].

Work in Process- Work tasks that have started, but are not completed as of the reporting cut-off date [Ref. 4:p. 522].

APPENDIX B
ABBREVIATIONS

AAE- Army Acquisition Executive [Ref. 83:p. A-1]
ACAT- Acquisition Category [Ref. 83:p. A-1]
ACO- Administrative Contracting Officer [Ref. 83:p. A-1]
ACWP- Actual Cost of Work Performed [Ref. 83:p. A-1]
AFIT- Air Force Institute of Technology [Ref. 83:p. A-1]
ASN (RD&A)- Assistant Secretary of the Navy, Research,
Development, and Acquisition [Ref. 83:p. A-2]
ATF- Advanced Tactical Fighter [Ref. 54:p. 1].
BAC- Budget at Completion [Ref. 83:p. A-3]
BCWP- Budgeted Cost of Work Performed [Ref. 83:p. A-3]
BCWS- Budgeted Cost of Work Scheduled [Ref. 83:p. A-3]
CAO- Contract Administration Office [Ref. 83:p. A-3]
CAPPS- Contract Appraisal Module [Ref. 35:p. 1].
CBB- Contract Budget Base [Ref. 4:p. 505]
CDRL- Contract Data Requirements List [Ref. 4:p. 505]
CPA- Cost Performance Analysis [Ref. 56:p. 4].
CPAWG- Cost Performance Analysis Working Group [Ref. 56:p. 4].
CPI- Cost Performance Index [Ref. 4:p. 507].
CPM- Cost Performance Measurement [Ref. 56:p. 4].
CPMC- Contractor Performance Measurement Course [Ref. 44].
CPR- Cost Performance Report [Ref. 4:p. 507]

CPR-EZ- Cost Performance Report EZ [Ref. 36:p. 34].

C/SCSC- Cost/Schedule Control Systems Criteria [Ref. 4:p. 507].

C/SSR- Cost/Schedule Status Report [Ref. 4:p. 507].

CV- Cost Variance [Ref. 4:p. 507].

CWBS- Contract Work Breakdown Structure [Ref. 83:p. A-5].

DAB- Defense Acquisition Board [Ref. 83:p. A-5].

DAES- Defense Acquisition Executive Summary [Ref. 83:p. A-5].

DCAA- Defense Contract Audit Agency [Ref. 83:p. A-5].

DCMAO- Defense Contract Management Area Operations [Ref. 83:p. A-5].

DCMC- Defense Contract Management Command [Ref. 83:p. A-5].

DFARS- Defense Federal Acquisition Regulation Supplement [Ref. 83:p. A-6].

DID- Data Item Description [Ref. 83:p. A-6].

DLA- Defense Logistics Agency [Ref. 83:p. A-6].

DLSIE- Defense Logistics Studies Information Center [Ref. 83:p. A-6].

DPRO- Defense Plant Representative Office [Ref. 83:p. A-6].

DSMC- Defense Systems Management College [Ref. 83:p. A-6].

DTIC- Defense Technical Information Center [Ref. 83:p. A-7].

EAC- Estimate at Completion [Ref. 83:p. A-7].

ESAR- Extended Subsequent Application Review [Ref. 4:p. 510].

ETC- Estimate to Completion [Ref. 4:p. 509].

FAR- Federal Acquisition Regulation [Ref. 83:p. A-7].

G&A- General and Administrative [Ref. 4:p. 511].

IPT- Integrated Product Team [Ref. 54:p. 2].

GFE- Government Furnished Equipment [Ref. 83:p. A-8].

JIG- Joint Implementation Guide [Ref. 6:p. i].

LRE- Latest Revised Estimate [Ref. 83:p. A-11].

MAR- Major Aircraft Review [Ref. 41:p. 1].

MOA- Memorandum of Agreement [Ref. 83:p. A-11].

M/TIS- Management/Technical Information System
[Ref. 54:p. 2].

NAE- Navy Acquisition Executive [Ref. 83:p. A-12].

NAVAIR- Naval Air Systems Command [Ref. 83:p. A-12].

NAVSEA- Naval Sea Systems Command [Ref. 83:p. A-12].

NSIA- National Security and Industrial Association
[Ref. 57:p. 1].

OSD- Office of the Secretary of Defense [Ref. 83:p. A-14].

OTB- Over Target Baseline [Ref. 4:p. 515].

PA- Performance Analyzer [Ref. 36:p. 33].

PAT- Process Action Team [Ref. 56:p. 4].

PEO- Program Executive Officer [Ref. 83:p. A-14].

PERT- Program Evaluation and Review Technique [Ref. 83:p. A-14].

PM- Program/Project Manager [Ref. 83:p. 516].

PMB- Performance Measurement Baseline [Ref. 83:p. 516].

PMC- Program Management Course [Ref. 44].

PMJEG- Performance Measurement Joint Executive Group [Ref. 83:p. 516].

R&D- Research and Development [Ref. 83:p. A-16].

RFP- Request for Proposal [Ref. 83:p. A-16].

SAR- Subsequent Application Review [Ref. 6:p. 7-1].

SARDA- Assistant Secretary of the Army, Research,
Development, and Acquisition [Ref. 44].

SPI- Schedule Performance Index [Ref. 4:p. 520].

SV- Schedule Variance [Ref. 4:p. 520].

SOW- Statement of Work [Ref. 83:p. A-17].

SYSCOMS - Systems Commands [Ref. 83:p. A-18].

TAB- Total Allocated Budget [Ref. 4:p. 520].

TCPI- To Complete Performance Index [Ref. 4:p. 521].

TQM- Total Quality Management [Ref. 83:p. A-19].

USD(A)- Under Secretary of Defense (Acquisition) [Ref. 83:p.
A-19].

VAC- Variance at Completion [Ref. 4:p. 521].

WBS- Work Breakdown Structure [Ref. 4:p. 522].

APPENDIX C
DOD FEDERAL ACQUISITION REGULATION SUPPLEMENT
CONTRACT CLAUSE

252.234-7001 Cost/Schedule Control Systems. As prescribed in 234.005-70, use the following clause:

COST/SCHEDULE CONTROL SYSTEMS (DEC 1991)

- (a) The Contractor shall establish, maintain, and use in the performance of this contract cost/schedule control systems (C/SCS) meeting the criteria of DoDI 5000.2, Defense Acquisition Management Policies and Procedures.
- (b) Within 90 calendar days of contract award, or a longer period if the Contracting Officer agrees, the Contractor shall:
 - (1) Furnish the Contracting Officer a description of the C/SCS applicable to this contract. The description shall:
 - (i) Be in the form and detail as indicated by the AFSCP 173-5, AMC-P 715-5, NAVSO P3627, DLAH 8400.2, DCAA P7641.47 Cost Schedule Control Systems Criteria Joint Implementation Guide (the Guide); or
 - (ii) Be in the form and detail required by the Contracting Officer.
 - (2) Be prepared to demonstrate the operation of the Contractor's C/SCS to the Government for compliance with the criteria of DoDI 5000.2
- (c) The Contracting Officer shall reference the description of the accepted C/SCS in the contract. The Contractor shall maintain and use the accepted C/SCS in the performance of this contract.
- (d) The Contractor shall submit proposed changes to the accepted C/SCS to the Contracting Officer for review and approval. The Contracting Officer shall advise the

Contractor of the acceptability of such changes within 60 days after receipt.

- (e) When systems existing at time of contract award do not comply with the criteria, the Contractor shall make adjustments necessary to ensure compliance at no change in contract price or fee.
- (f) The Contractor agrees to provide access to all pertinent records and data requested by the Contracting Officer or duly authorized representative. Access is for the purpose of reviewing the demonstration in paragraph (b) of this clause and also to permit Government surveillance to ensure continuing application of the accepted systems to this contract.
- (g) The Contractor shall correct deviations from accepted systems discovered during contract performance, as directed by the Contracting Officer.
- (h) The Contractor shall require that each selected subcontractor, as agreed to by the Contracting Officer, shall meet the C/SCS criteria as set forth in the Guide. All such subcontracts shall have provisions for demonstration, review, acceptance, and surveillance of systems, to be conducted by the Government, at its option, when requested by the Contractor or subcontractor.
- (i) If the Contractor or subcontractor is utilizing C/SCS which have been previously accepted, or is operating such systems under a current Memorandum of Understanding, the Contracting Officer may waive all or part of the provisions concerning demonstration and review.

(End of clause)

APPENDIX D
COMPREHENSIVE C/SCSC COMPLIANCE PLAN
SOLICITATION PROVISION

252.234-7000 Notice of Cost/Schedule Control Systems. As prescribed by 234.005-70, use the following provision:

COST/SCHEDULE CONTROL SYSTEMS (DEC 1991)

- (a) The Offeror shall submit a comprehensive plan for compliance with the cost/schedule control systems criteria of DoDI 5000.2, Defense Acquisition Management Policies and Procedures. The plan shall:
- (1) Describe the cost/schedule control systems (C/SCS) the Offeror intends to use in performance of the contract.
 - (2) Distinguish between the Offeror's existing management systems and modifications proposed to meet the criteria.
 - (3) Describe the management systems and their application in all major functional cost areas in terms of:
 - (i) The work breakdown structure,
 - (ii) Planning,
 - (iii) Budgeting
 - (iv) Scheduling,
 - (v) Work authorization,
 - (vi) Cost accumulation,
 - (vii) Measurement and reporting of cost and schedule performance,
 - (viii) Variance analysis, and
 - (ix) Baseline control.

- (4) Describe compliance with each of the criteria.
(Preferably, cross-reference appropriate elements in the description of systems with the items in the checklist for the C/SCS criteria in AFSCP 173-5, AMC-P 715-5, NAVSO P3627, DLAH 8400.2, DCAA P7641.47, Cost/Schedule Control Systems Criteria Joint Implementation Guide).
- (5) Identify the major subcontractors, or major subcontracted effort if major subcontractors have not been selected, planned for application of the criteria.
- (6) Describe the proposed procedure for administration of the criteria as applied to subcontractors.
- (b) If the Offeror is using C/SCS which have been accepted by the Government, or is operating C/SCS under a current Memorandum of Understanding, the Offeror may submit either instead of the comprehensive plan.
- (c) The Offeror shall provide information and assistance as requested by the Contracting Officer for evaluation of compliance with the cited criteria.
- (d) The Government will evaluate the Offeror's plan for C/SCS before contract award.
- (e) The prime contractor and the Government shall agree to subcontractors selected for application of the C/SCS criteria. The Contractor will contractually require the selected subcontractors to comply with the criteria. If either the prime or subcontractor requests, the Government, at its option, may conduct demonstrations and reviews of these selected subcontractors' management systems.

(End of provision)

APPENDIX E

CPR FORMAT ONE EXAMPLE

CONTRACTOR: Rothco Aerospace, Inc. Rothco Division LOCATION: Quincy, MA		COST PERFORMANCE REPORT - WORK BREAKDOWN STRUCTURE													
CONTRACT TYPE/NO. CPW-A00010-73- C-0187		PROGRAM NAME/NUMBER Boeing/MBB-00A				REPORT PERIOD December		SIGNATURE, TITLE & DATE PROGRAM DIRECTOR January				FORM APPROVED ONE NUMBER 2200200			
QUANTITY 50 Modules 10 Modules	NEGOTIATED COST \$22422	EST COST WITH UNPRICED WORK 0	TST PROFIT/PER % 5.2	TST PRICE 218220	EST PRICE 207307	SHARE RATIO 55/15	CONTRACT CEILING		EST CONTRACT CEILING						
LEVEL 2 ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					REPROGRAMMING ADJUSTMENTS		AT COMPLETION		
	SUSPECTED COST		ACTUAL COST	VARIANCE		SUSPECTED COST		ACTUAL COST	VARIANCE		COST VARIANCE	CUMET	SUSPECTED	LATEST REVISED ESTIMATE	VARIANCE
	WORK SCHEDULED	WORK PERFORMED	WORK PERFORMED	GENERAL	COST	WORK SCHEDULED	WORK PERFORMED	WORK PERFORMED	GENERAL	COST					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
WORK BREAKDOWN STRUCTURE															
MISSILE SYSTEM															
AIR VEHICLE	3007	3006	3006	(207)	(000)	20100	23077	20001	(4202)	(0004)			71000	71227	(227)
COMMAND & LAUNCH EQUIPMENT	0070	0064	0147	(10)	(00)	24772	23000	20000	(1200)	(0002)			02404	02200	(204)
TRACKED VEHICLE	1000	1000	1000	(00)	0	0300	0104	0400	(200)	(300)			23000	22200	(210)
TRAINING	70	70	00	0	(0)	274	271	200	(0)	(14)			1000	1000	0
PROBABLE SUPPORT EQUIPMENT	24	20	20	(1)	0	110	110	114	(4)	1			2300	2300	0
SYSTEMS TEST & EVALUATION	700	000	700	(70)	(100)	0407	0000	0070	(000)	(1000)			20001	20000	(014)
PROJECT MANAGEMENT	000	040	004	10	10	7070	7300	7470	(100)	(00)			10000	10000	0
DATA	100	100	100	0	0	004	004	011	10	(7)			0000	0000	000
REPAIR PARTS	0	0	0	0	0	0	0	0	0	0			0000	0000	0
COST OF MONEY	200	200	204	(7)	(0)	1010	1071	1700	(100)	(200)			0220	0207	(20)
GENERAL & ADMINISTRATIVE	1000	1001	1040	(41)	(00)	10400	0004	11000	(0400)	(1004)			20700	20074	(626)
UNRESERVED BUDGET													0	0	0
SUBTOTAL	10000	10170	10004	(274)	(400)	00701	70047	01002	(7004)	(10070)			200400	201000	(1000)
MANAGEMENT RESERVE													11000	0	11000
TOTAL	10000	10170	10004	(274)	(400)	00701	70047	01002	(7004)	(10070)			200400	201000	10000
RECONCILIATION TO CONTRACT BUDGET BASE															
VARIANCE ADJUSTMENT															
TOTAL CONTRACT VARIANCE															

CPR Format1-Work Breakdown Structure

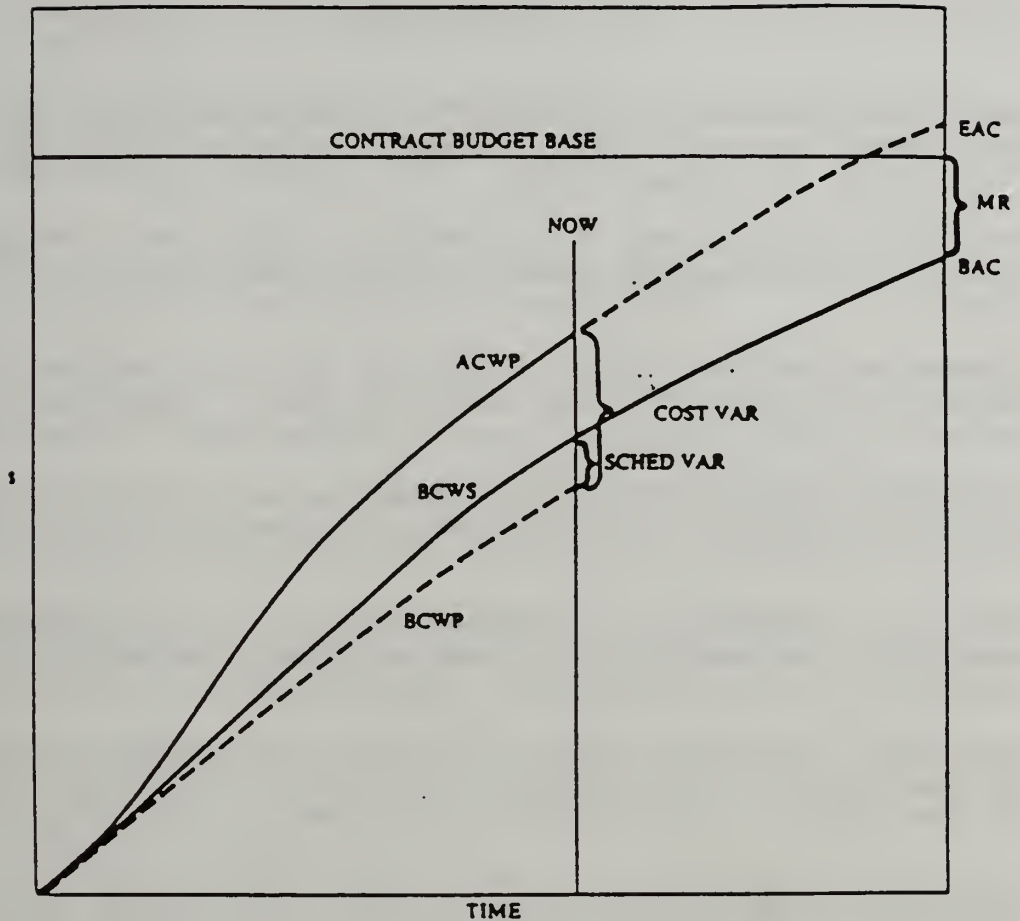
APPENDIX F

AIR FORCE SYSTEMS COMMAND'S ADDRESS/PHONE NUMBER

HQ, AFSC/ACCI
ANDREWS AFB, MD
20334-5000

TELEPHONE: (301) 981-5143 or
AUTOVON 858-5143

APPENDIX G CUMULATIVE PLAN/STATUS GRAPH



MR- Management Reserve
 EAC- Estimate at Completion
 ACWP- Actual Cost of Work Performed
 BCWP- Budgeted Cost of Work Performed
 BCWS- Budgeted Cost of Work Scheduled

APPENDIX H

INTERVIEWS

Interview between Mr. Wayne Abba, Program Analyst, Office of the Under Secretary of Defense (Acquisition), and the researcher, 30 January 1992.

Interview between Mr. Larry Brewer, President, Brewer and Brewer Inc. Automated Systems, and the researcher, 29 October 1991.

Interview between Mrs. Adeliza Cordis, Chief Systems Engineering Branch, Defense Contract Management Area Operation, San Francisco, and the researcher, 26 April 1991.

Interview between CPT Jim Curl, Program and Technical Support, DCMAO Los Angeles, California, and the researcher, 29 October 1991.

Interview between Mr. Gerald Dockins, Business/Financial Manager, Longbow-Apache Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

Interview between Mrs. Char Ellington, Procurement Production Analyst, Army Aviation Systems Command, and the researcher, 8 August 1991.

Interview between Mr. R.L. Endicott, Office of the Assistant Secretary of the Army, RD&A, and the researcher, 4 February 1992.

Interview between COL David R. Forville, U.S. Army, Program Manager, Longbow Apache Program, Army Aviation Systems Command, and the researcher, 6 August 1991.

Interview between Mr. Howard Gilby, Program Management and Operations Division Manager, Light Helicopter Program, Army Aviation Systems Command, and the researcher, 9 August 1991.

Interview between Mr. Ward Gillespie, Division Chief, Cost and Economic Information System Division, Army Aviation Systems Command, and the researcher, 9 August 1991.

Interview between Mr. Ron Gormont, Deputy Program Manager, Utility Helicopter Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

Interview between BG Otto J. Guenther, U.S. Army, Program Executive Officer, Communications Systems, and the researcher, 29 January 1992.

Interview between Mr. Robert Hubbard, Deputy Program Manager, Light Helicopter Program, Army Aviation Systems Command, and the researcher, 7 August 1991.

Interview between COL James Huey, U.S. Army, Program Manager, Army Helicopter Improvement Program, Army Aviation Systems Command, and the researcher, 8 August 1991.

Interview between Mr. Larry Johnston, Program Manager, Avionics Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

Interview between Ms. Shamim Khan, Surveillance Monitor, Defense Contract Management Area Operation, San Francisco, and the researcher, June 1991.

Interview between Mr. Earl Krueger, Operations Research Analyst, Blackhawk Program, Army Aviation Systems Command, and the researcher, 6 August 1991.

Interview between Dr. David V. Lamm, Academic Associate, Defense Systems Analysis (Acquisition), Department of Administrative Sciences, Naval Postgraduate School, and the researcher, 15 January 1992.

Interview between Mr. Gary Luker, Program Branch Manager, Light Helicopter Program, Army Aviation Systems Command, and the researcher, 7 August 1991.

Interview between BG Orlin Mullen, U.S. Army, Program Manager, Light Helicopter Program, Army Aviation Systems Command, and the researcher, 7 August 1991.

Interview between Mr. Harold W. Nelson, Project Manager, Ebasco Services, and the researcher, 28 December 1991.

Interview between LTC William Pekny, U.S. Army, Deputy Program Manager, Avionics Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

Interview between COL Thomas Reinkober, U.S. Army, Aircraft Survivability Equipment Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

Interview between LTC Bob Reuter, U.S. Army, Office of Acquisition Policy, Program Integration, and Cost Management, and the researcher, 31 January 1992.

Interview between Mr. Dave Robertson, Management Analyst, Defense Contract Management Command, and the researcher, 30 October 1991.

Interview between Mr. Chuck Sell, U.S. Navy C/SCSC focal point, and the researcher, 30 October 1991.

Interview between Mr. Jim Smith, Program Branch Cost Analyst, Light Helicopter Program, Army Aviation Systems Command, and the researcher, 7 August 1991.

Interview between Mr. Larry Stone, Chief of the Contract Cost Performance Division, Deputy Chief of Staff for Resource Management, HQ, U.S. Army Materiel Command, and the researcher, 29 October 1991.

Interview between Mr. Rick Sylvester, Assistant Deputy Director for Acquisition Policy, Office of the Secretary of Defense (Acquisition), and the researcher, 15 August 1991.

Interview between Ms. Francis Velore, Professor, Cost Performance Measurement Curriculum, Defense Systems Management College, and the researcher, 29 October 1991.

Interview between RADM William Vincent, U.S. Navy, Commandant, Defense Systems Management College, and the researcher, 5 February 1992.

Interview between Mrs. Chris Waddell, Cost Analyst, Longbow-Apache Program, Army Aviation Systems Command, and the researcher, 5 August 1991.

APPENDIX I

WORKSHOP ATTENDED

Cost/Schedule Control Systems Criteria National Workshop,
Falls Church, Virginia, 28-30 October 1991.

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